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The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

and

The Foundry Trades' Equipment and Supplies Association

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Old and New

Few developments have been more disconcerting to the foundry metallurgist than the growth of knowledge about crystal structures as revealed by X-rays. We say disconcerting because most of us have been brought up on the conceptions of what is now called classical physics, and to read Papers and text-books essentially based on the space lattice is like having to learn an entirely new language and an entirely new method of approach. Again, a man familiar with modern atomic physics and a man brought up on the older brand find technical discussion far from easy because their mental approaches are so different. For example, the latter regards the idea of a eutectic as something sacrosanct, as a conglomeration behaving in certain definite ways and making certain responses to tests which assure him that in fact it is a eutectic, while the former regards it as a convenient sort of framework for thinking but as having little correspondence with actual facts—an outlook which reflects the greater precision in idea and power of measurement given by the new technique. This says that a true crystal has its atoms arranged according to a definite pattern on a measurable scale. A grain is a family of crystals, the geometrically arranged atoms of which define a series of planes separated by a fixed distance, fixed, that is, for a given type of material. By using one of these planes as a mirror for an X-ray beam, the perfection or otherwise of the grain can be studied by the sharpness or otherwise of the X-ray reflection. Thus it becomes practicable to study on a minute scale in terms of the ultimate units of matter the effects of stress, deformation, fracture, and so on. On similar lines the mode of spacing of the atoms and the structure of the unit crystal can be studied, and it becomes possible to get at the consequence of one metal dissolving in another or combining with another. The results of this work on both ferrous and non-ferrous metals are to be found in a shoal of Papers, and are now spreading to the text-books. The amount is startling, when we recall that it has been done in a very few years and that the majority of the physicists who have done it are still with us. Where it will take us nobody would care to prophesy, but since the quantity and arrangement of material in engineering design is based on a knowledge of the material itself, it is bound to be a long way. Its importance justifies every effort on the part of practising metallurgists to understand, to sympathise with, and to encourage it as a development full of significance for industry.

The Bradford Conference

The 35th Annual Conference of the Institute of British Foundrymen is this year to be held in Bradford, and the venue is a particularly happy one. The West Riding of Yorkshire is one of the foremost foundry centres in the country, yet this is the first occasion that it has been chosen for a national conference of foundry executives. This means that no less than eight works will be visited for the first time. Moreover, the diversity of manufactures undertaken by these firms is particularly wide, ranging as it does from piston rings to traction engines, and embracing intermediately textile machinery, machine tools, valves and chemical equipment. From the metallurgical aspect, it covers all types of founding, except, perhaps, light alloys.

Bradford is indeed fortunate in the Papers to be presented. Once again, the non-ferrous founder is well catered for by the inclusion of three valuable Papers. Two of these are by eminent foreign metallurgists, Mr. G. G. Gauthier (France) and Mr. G. Guertler (Germany), both of whom deal with aluminium alloys, whilst the third comes from the pen of Mr. J. E. Newson, and covers some factors in the casting of high-strength brasses. Steel-foundry practice is to be covered by two Papers, one on the Randupson process, by Mr. F. W. Rowe, and another by Dr. Dadswell, which will contrast American and British practice. Cast iron is to be studied from the angles of stress relief, alteration of composition during melting, and when alloyed with copper. The authors include Dr. J. T. Mackenzie, the distinguished American metallurgist, Mr. A. J. Nicol Smith, Mr. J. Blakiston, Mr. L. E. Benson and Mr. H. Allison. Finally, a Paper which should have a very wide appeal is one on sand-blasting by Mr. H. Whitaker.

The President-Elect, Mr. Joseph Hepworth, J.P., M.P., is among the most prominent of Bradford's citizens, and he has been able to obtain the fullest possible and most cordial support and co-operation from the civic authorities, and a hearty welcome is being extended on behalf of the City by the Lord Mayor (Alderman Henry Hudson) to all members of the Institute and their ladies to participate in the hospitality which Bradford is arranging for their acceptance.

American Notes

(FROM A SPECIAL CORRESPONDENT.)

Invar Castings

The compensating supports of the 200-in. telescope now under construction at the Westinghouse plant in Philadelphia were cast of 36 per cent. nickel steel (Invar metal). The decision to use this alloy was based on the fact that it exhibits a minimum linear coefficient of expansion in the temperature range of 0 to 79 deg. C. A total of 246 castings, weighing 5 tons 8 cwts., was made in all.

In order to obtain suitable physical properties, together with the required low linear coefficient of expansion, special heat-treatments were given to the castings to develop these properties and to ensure stabilisation. The linear coefficient of each heat was determined by means of a modified Rockwell dilatometer from 0 to 79 deg. C., which showed a linear coefficient of expansion from 2.2 in. by 10^{-7} to 2.8 in. by 10^{-7} per deg. C. The castings ranged in weight from 20 to 78 lbs. each, and were furnished in the rough, being machined in the Mechanical Laboratories of the California Institute of Technology.

* * *

Tungsten-Titanium-Carbide Cutters

The United States Patent Office at Washington, D.C., has granted a patent to Mr. Philip M. McKenna, of Unity Township, Pa., for a new synthesised chemical compound, claimed to be harder than some of the toughest abrasives known. The new compound, tungsten-titanium-carbide, has a direct relation to tungsten carbide, titanium carbide and carborundum. A high commercial value is placed on the compound, and it has already been adopted for use in cutting points and dies for cutting metals at high speeds. In powdered form and moulded with a suitable binder into grinding wheels it is claimed to outlast four to five times similar grinding wheels made from tungsten-carbide and titanium-carbide mixtures.

The formula for the new compound includes tungsten, nickel as the melting stock, and powdered titanium dioxide. These are placed in a graphite crucible and heated to 2,000 deg. C. for 8 hrs. After cooling, crucible and contents are crushed, and nitric and hydrochloric acids remove the nickel and other impurities, leaving grey, metallic-lustred particles of the chemical compound. It is claimed that the compound, melting at extremely high temperatures, will retain its keen edge even at white heat when shaped into cutting tools.

* * *

Cast Iron in House Construction

About 3½ tons of products made from steel, wrought iron and cast iron are used in the construction and equipment of a typical small dwelling costing approximately £800, according to the American Iron and Steel Institute. The total cost of metals is estimated at about £34, approximately 4 per cent. of the cost of the dwelling. The total of 7,870 lbs. of such products is required in the building of the house and in the plumbing and heating equipment. It does not include iron and steel equipment used in furnishing the house. It is estimated that more than 930 lbs. additional is required for the kitchen range, washing machine, electrical refrigerator, cooking utensils, springs in mattresses, chairs and a settee, as well as in pedestal lamps, cutlery, and so on.

Bulking largest in the total weight of items of equipment are products made of cast iron. A total of 4,250 lbs. of cast iron is used in the radiators, steam boilers, plumbing, bathtubs, wash basins, laundry tub, and kitchen sink. Likewise, included in the total are such miscellaneous cast-iron items as 158 lbs. of sash weights, 15 lbs. of valves, and a coal-shute weighing 122 lbs.

Iron-Chromium-Manganese Alloys

The constitution of iron-chromium-manganese alloys was discussed recently by C. O. BURGESS and W. D. FORGENG in a Paper delivered before the American Institute of Mining and Metallurgical Engineers, and the following are the conclusions they have arrived at.

The ternary sections of the iron-chromium-manganese system developed in the investigation resemble corresponding sections of the iron-chomium-nickel system. This is to be expected, since manganese, in common with nickel, promotes the formation and stability of austenite in iron-chromium alloys. When added to iron-chromium alloys, however, manganese is much less influential than an equal amount of nickel in creating and preserving a completely austenitic structure. For example, while a low-carbon 18 per cent. Cr: 8 per cent. Ni alloy can be rendered fully austenitic, an 18 per cent. Cr. alloy of low-carbon content in which 8 per cent. Mn takes the place of the nickel will not be made completely austenitic by any heat-treatment, but will consist of alternate grains of austenite and ferrite. The relatively lower austenite stabilising power of manganese is immediately apparent in any comparison of the two alloy systems, and in fact it has been recognised that the austenitising effect of manganese is about half that of nickel.

It should be borne in mind that while the addition of as little as 8 per cent. Mn to a 15 per cent. Cr alloy will yield a ductile alloy consisting of approximately equal parts of stable austenite and ferrite, the further addition of manganese even up to 50 per cent. will not render a low-carbon alloy of this or higher chromium content completely austenitic. This is clearly brought out in the ternary diagrams of the iron-chromium-manganese system shown in the Paper.

The sigma phase, which can be developed by suitable heat-treatment in alloys containing sufficient chromium and manganese, undoubtedly bears a close similarity to both the *B* constituent in iron-chromium-nickel alloys and the "FeCr compound" now commonly associated with the iron-chromium system. The approximate limits of composition and temperature within which the sigma phase will form in the iron-chromium-manganese alloys have been systematically determined. Two methods were developed for the ready detection of this phase, one depending on the anisotropic effects shown by the phase when etched in a specified manner, and the second depending on the use of an etching reagent that selectively colours the sigma phase. From the characteristics of the sigma phase and its variable composition, the opinion is advanced that the sigma phase results from an allotropic transformation of a highly saturated ferrite, and is not considered to be an intermetallic compound. Complete saturation may evidently be brought about when either the chromium or the combined chromium and manganese contents of a ferritic phase are in the range of 40 to 50 per cent.

It should be stressed that iron-chromium-manganese alloys containing up to approximately 20 per cent. Cr and 12 per cent. Mn do not contain the sigma phase as quenched, as forged, or as furnace-cooled, and that extended holding at temperatures below 800 deg. C. is necessary for the development of the phase, and it is doubtful whether the phase can be developed in finite time in alloys containing somewhat lower amounts of manganese and chromium. These latter alloys exhibit an alpha or a mixed alpha-gamma structure under normal cooling conditions, the quantity of retained austenite or gamma phase naturally increasing with an increase in the manganese content of the alloy.

(*Concluded in next column.*)

(*Concluded from previous column.*)

It is realised that the alloys considered in this investigation are only of commercial quality and contain appreciable amounts of both carbon and silicon. It is felt, however, that the establishment of approximate isothermal sections of the system will stimulate further research and be of value in predicting the phases that can be developed in iron-chromium-manganese alloys.

Random Shots

Whilst leaving the cynics to argue that it was really Scotland that won last Saturday's Cup Final, the whole matter might easily be dismissed in a single phrase: Huddersfield Preston but Much Hadam.

* * *

May has come in with a return to almost winter conditions, but football has automatically gone out and cricket inevitably come in. Those who are wont to criticise the youth of England for their lack of the yeoman spirit, should have left their warm firesides last Sunday to see the many hardy lads who turned out so cheerfully in the bitter wind to shiver in the slips in thin shirts and white flannels. And in doing so they are only keeping up a fine English tradition. World affairs may be upset and the weather be all topsy turvy, as it were in sympathy, but so long as the cricket season continues to start in May and the football season in September one feels that England at least is keeping her head.

* * *

The "royal and ancient" game, however, knows no season. Cricket may come and football may go, but golf goes on for ever. That is why the foundrymen's match at Matlock promises to be a very interesting sporting event, for there the spectators will witness a display of real keenness and no small skill. Good golf and bad (foundry) language will no doubt be the order of the day. No wonder the Committee suggests leaving the ladies behind in Matlock to sip the medicinal waters in a pure, clean atmosphere! The committee emphasises, too, its wish that all classes of player should take part, and there are, happily, still a few more week-ends in which the not-so-goods can practise getting birdies in the hope of winning the Birdie Cup!

* * *

Many unbelievers who will travel, perhaps for the first time, up to Glasgow this summer for the Empire Exhibition will be able to prove for themselves that strange fact: namely, that starting from London it is further to Glasgow than to Paris, generally costs more and usually takes longer to get there!

* * *

At the recent banquet of the Institute of Mining and Metallurgy a pretty wit was displayed by one of the speakers who said of the new Budget that he grudged Simon the Tanner, whilst another, replying to the speech, declared that he didn't mind paying a bit, but only a threepenny bit!

* * *

Londoners are more or less accustomed to being asked by foreign visitors to be directed to "Soottelong" (South Ealing), and the right platform for "Brigton," but a new puzzler has been added to the list by a friend who was recently asked the way to "Cheeapsidday" (Cheapside)!

* * *

Likewise, a provincial visitor to London, diving into the Underground at Notting Hill Gate, nervously asked the conductor if his train went to Kensington.

"Westken, Southken, Northken or Kenhigh?" hurriedly demanded the conductor. "Me no talkie Chinese," gasped the bewildered inquirer, dejectedly looking round for someone who could talk English.

"MARKSMAN."

Institute of British Foundrymen

BRANCH ANNUAL GENERAL MEETINGS

BIRMINGHAM BRANCH

A year of outstanding success was under review at the annual general meeting of the Birmingham, Coventry and West Midlands Branch, held at the James Watt Memorial Institute, Birmingham, on April 22. The retiring Branch-President (Mr. H. J. Roe) was in the chair.

The annual report presented by Mr. A. A. Timmins (Hon. Secretary) stated that the past session would stand out as a milestone in the growth of the Branch. There had been a substantial increase in the number of members, 38 new members having been elected, while 8 had resigned. Four had been transferred to other Branches, and three had died. The present membership stood at 330, being the highest yet recorded, and placing the Branch as the second or third largest in the Institute. The growth in membership over the past four years was shown by the following figures: 1935, 242; 1936, 268; 1937, 307; 1938, 330. It was with deep regret that the death was recorded during the year of two past Branch-Presidents, Mr. J. B. Johnson and Mr. E. H. Tyson.

Seven meetings had been held during the session, at which Papers dealing with a wide variety of subjects were presented. At two of the meetings, namely those on costing and non-ferrous foundrywork, invitations were extended to the Institute of Vitreous Enamellers and the Electrodepositors' Society. Attendance at Branch meetings was again a little disappointing, and showed a slight decrease as against last year, the average being 47, against 50. This might be accounted for partly by the lack of purely practical Papers. The lectures, however, even though technical, had been such as to be of fundamental interest to all members.

In October the first Birmingham Inter-Branch meeting was held, at which members of the London Branch were invited to Birmingham. Twenty-two London members and 87 Birmingham members took part in the conference, which consisted of visits to Sterling Metals, Limited (Coventry), and Midland Electric Manufacturing Company, Limited (Birmingham). An informal supper was held in the evening. On the Saturday morning the Austin motor works at Longbridge were visited. Through the courtesy of the company, lunch was taken there, and the afternoon was devoted to the presentation of Papers. Mr. C. H. Kain (London) gave a lecture on "Can the Metallurgist run the Foundry?" whilst Mr. Tipper presented a Paper entitled "Synthetic *versus* Natural Sand." The conference was voted to be a big success.

The annual dinner and dance in January was highly successful. There was an attendance of 206 members and ladies, the principal guests being Alderman W. Byng Kenrick and the President and Secretary of the Institute. No financial loss was incurred.

The Branch had had a very successful year financially, the subscription income, £456 1s. 6d., being the highest yet recorded. This income represented £100 increase over last year and was about 40 per cent. greater than in 1932. The balance at the end of the year was £34 10s. 9d., as against £44 10s. last year. The expenditure had been greater—£106 2s., as against £85 last year.

In conclusion, Mr. Timmins thanked members of the Council for their co-operation during the year.

The report and accounts were adopted.

Election of Officers

The BRANCH-PRESIDENT, proposing as his successor Mr. W. J. Molineux (senior Vice-President), expressed sincere regret that, owing to illness, Mr. Molineux was unable to be present. Mr. Molineux, he said, who was a very old member of the Branch, left Birmingham for a time for the North-East Coast, and became Senior Vice-President of the Newcastle Branch. Later he returned to Birmingham and had filled the same office in the Birmingham Branch.

MR. L. W. BOLTON seconded the motion, which was carried.

Mr. L. W. Bolton, Junior Vice-President, was elected to the senior position, and Mr. A. Tipper was appointed Junior Vice-President.

Other appointments were:—*Branch Council*, Mr. T. H. Gameson, Mr. W. Todd and Mr. Shaw. *Branch delegates to General Council*, Mr. L. W. Bolton, Mr. G. W. Brown, and Mr. G. T. Lunt. *Delegates to Technical Committee*, Mr. J. R. Shotton and Mr. Bolton. *Branch Auditors*, Mr. G. M. Callaghan and Mr. W. L. Johnson. Mr. A. A. Timmins was asked to continue to serve as Hon. Secretary and Treasurer and was warmly thanked for his services. The Council was also thanked for work successfully accomplished in the interests of the Branch.

Following the business meeting, it had been intended to conduct a Short Paper Competition, but there were no entries. MR. J. J. SHEEHAN filled the gap at short notice by contributing a Paper on "Cire Perdue" (lost wax process), which was made more interesting by lantern slides and a number of examples of art castings. Mr. Sheehan confessed that the title was misleading and said a more exact definition would be "The Lost Process for the Manufacture of Art Castings by the Use of Wax Patterns." It was not the wax which was lost, but the process.

EAST MIDLANDS BRANCH

The annual meeting of the East Midlands Branch was held at Loughborough College.

The minutes of the last annual meeting having been read and confirmed, and the auditors' report presented by Mr. Butters, Mr. Gale (Hon. Secretary) presented his report of the past session's work. That session, he said, had been most successful. Since the last annual meeting the Branch had been responsible for the annual conference of the Institute at Derby, which had been acclaimed as one of the most successful held. The Branch-President (Mr. Evans) had been responsible for the introduction of the series of lectures during the session, which were concluded that evening by a summing-up of the series by Mr. Sanders. The programme was unique inasmuch that every Paper had been presented by a member of the East Midlands Branch, no fewer than ten members presenting Papers.

The Branch had held seven ordinary meetings, with an average attendance of 66, which was a record. One works visit was also arranged which attracted 71 members.

Regarding progress in the membership of the Branch, since last March they had enrolled one subscribing firm, four members, seven associate members, and two associates, and in addition ten associate members had transferred to a higher grade. Four members had resigned during the year, leaving the membership of all classes as 157, the highest figure yet attained.

An innovation during the year was the first dinner and dance, to which the ladies were invited. This had been a distinct success, and was attended by 128 members, ladies and friends.

MR. H. BUNTING, proposing the adoption of the report, said the Branch could congratulate themselves that they had a man who could so successfully fill the position of Branch Secretary. He proposed a vote of thanks to the secretary.

The election of officers for next session was as follow:—

President.—Mr. R. Spriggs (Loughborough).

Senior Vice-President.—Mr. R. H. Buckland (Derby).

Junior Vice-President.—Mr. S. E. Dawson (Nottingham).

Hon. Secretary.—Mr. B. Gale.

Hon. Auditors.—Mr. W. H. Smith and Mr. F. G. Butters.

Delegates to General Council.—Mr. R. H. Buckland and Mr. A. E. Peace.

Representatives on Technical Committees.—Mr. P. A. Russell and Mr. A. E. Peace.

Following the business of the annual meeting, Mr. H. L. Sanders gave a summing-up of the Papers and discussions during the session.

SHEFFIELD BRANCH

The annual general meeting of the Sheffield Branch was held at the Royal Victoria Station Hotel, Sheffield, on April 7.

MR. J. B. ALLAN, M.A. (Branch-President), who was in the chair, drew attention to a competition for apprentice patternmakers which the Council of the Sheffield Branch was arranging for the coming summer. Three prizes were to be offered, and Mr. Allan, pointing out that they wanted to make the competition a real success, asked members to do what they could towards that end.

Election of Officers

The BRANCH-PRESIDENT said it was usual for the Senior Vice-President to become President, and Prof. J. H. Andrew, Dean of the Faculty of Metallurgy of Sheffield University, who was the Senior Vice-President, would add considerable lustre to the Branch, and they would be honouring themselves by electing him.

The HONORARY SECRETARY (Mr. T. R. Walker) seconded, and Prof. Andrew was elected unanimously.

Mr. W. Brown was elected Senior Vice-President, and Mr. T. R. Walker (honorary secretary) was elected Junior Vice-President. MR. G. OFFILER, in proposing him, said Mr. Walker had served the Branch remarkably well for many years, and it would be extraordinarily difficult to find anywhere a better secretary. His election would be a suitable recognition of excellent service.

MR. ALLAN said members were well aware of the great amount of work Mr. Walker performed for the Branch. In many ways a secretary's task was a thankless one, but the success of a Branch depended very largely upon its secretary, and the Sheffield Branch was in a very healthy condition, due in large measure to Mr. Walker's efforts.

Other elections were as follow:—Honorary Secretary, Mr. T. R. Walker. As members of the Branch Council, Mr. F. E. Steele, Mr. F. Whitehouse and Mr. H. T. Winterton. As delegates to the Technical Council, Mr. C. D. Pollard and Mr. T. R. Walker. As delegates to the General Council, Mr. J. B. Allan and Mr. J. Roxburgh. Auditors, Mr. G. L. Oxley and Mr. S. Leetch.

Following the annual general meeting, Mr. J. E. Mercer and Mr. D. K. Barclay read a Paper on "Steel and Alloy Castings."

Jarrow Steelworks Project

At a meeting of Jarrow Town Council last week the Industries Committee reported that a letter had been sent to the Special Areas Commissioner expressing the Council's dismay at the delay in going on with the steelworks scheme for Jarrow. The Council asked to be informed when it was anticipated that constructional work would begin and also for an assurance that the utmost expedition would be used in the construction of the works and the commencement of operations. It was reported that the Commissioner had acknowledged the letter, and it was agreed that a deputation, which was to go to London on other Council business, should also obtain an interview with the Commissioner on the steelworks project.

The New Factories Act—II

THE SAFETY PROVISIONS

By F. J. TEBBUTT

The new Factories Act, the cleanliness and health provisions of which were described in the opening article last week, alters and amplifies existing provisions concerning safety in industry, and also introduces new obligations. In addition, there are various Regulations particular to various trades, and those relating to the foundry industry will be explained in detail.

At the outset it might be useful to note that the term "prime mover" means every engine, motor or other appliance which provides mechanical energy derived from steam, water, wind, electricity, the combustion of fuel or other source, the term "transmission machinery" meaning every shaft, wheel, drum, pulley, system of fast and loose pulleys, coupling, clutch, driving belt or other device by which the motion of a prime mover is transmitted to or received by any machine or appliance.

It is obligatory for every flywheel and every moving part of a prime mover to be securely fenced, whether the flywheel or prime mover is situated in an engine house or not. That applies ordinarily, although as regards parts of electric generators, motors and rotary converters and every flywheel in connection thereto, this obligation may be met without actual fencing, if the part or flywheel is in such a position or of such construction as to be as safe to every person employed on the premises as if it were fenced. This latter modification also applies in respect to every part of the transmission machinery; otherwise every such part must be securely fenced.

Fast and Loose Pulleys

The following provisions are also obligatory ordinarily, although the Home Secretary has power to give exceptions by Order, if he is satisfied that special circumstances make the requirements unnecessary or impracticable:—(1) efficient devices or appliances must be provided for cutting off power from the machinery in any work-room or place; (2) no driving belt when not in use must be allowed to rest or ride upon a revolving shaft; (3) suitable striking gear or other efficient appliances must be provided to move belts to and from fast and loose pulleys, and such gear or appliances must be placed so as to prevent the belt creeping back on to the fast pulley.

The foregoing provisions, it will be seen, apply to specially-named items, but every dangerous part of any other machinery must be securely fenced, unless it be in such a position or of such construction as to be as safe to every employee working on the premises as it would be if securely fenced. In most cases a fixed guard is required, but if the nature of the operation prevents this method of securing safety, the obligation is met if a device is provided which automatically prevents the operator from coming into contact with that part.

If the Home Office is satisfied that any particular type or description of safety device is best suited for stopping a machine forthwith in case of danger, or prevents the exposure of a dangerous part of machinery whilst in motion, the Act gives power for directing (by Regulations) that such device shall be used; but in case of proceedings under this power it will be a good defence to prove that an equally efficient device was being used in connection with the machinery concerned.

As regards lathes, if any part of a stock bar projects beyond the head-stock it must be fenced, unless it is considered as being in such a position as safe to every person employed as it would be if fenced.

Furthermore, power is given the Home Secretary to make Regulations, if it is considered necessary, requiring the fencing of materials or articles which are dangerous while in motion on the machine; this applies in respect of any machine or any process in which a machine is used.

Where it is claimed that any part of the machinery is in such a position as to be as safe to every person as if securely fenced, care must be taken to prevent anyone approaching unfenced machinery while in motion, but it is allowable for a male person (who must be 18 years of age) to carry out an examination, lubrication or adjustment, while the machinery is running, if the examination, etc., is an operation which must be carried out while the machinery is in motion. Power is taken to make Regulations in connection with this exception and with the following requirement. Fencing and other safeguards required must always be in position while the machinery is running, the only exception being in similar circumstances as just outlined, when examination, lubrication or adjustment is immediately necessary, and under conditions laid down in Regulations.

With regard to the term "dangerous parts of machinery," many legal decisions have been given on these points, and individual circumstances must often rule; but there exists broad case law that, if a machine or part of a machine is capable of causing injury, it comes under the fencing (or alternative methods) requirements.

New Machinery

A new provision arising out of the Report of the Committee on Accidents relates to the construction and sale of new machinery. It lays down that every set-screw, bolt or key on any revolving shaft, spindle, wheel or pinion must be so sunk, encased or otherwise effectively guarded as to prevent danger, and all spur and other toothed or friction gearing, which does not require frequent adjustment, while in motion shall be completely encased. When the machine is working in a factory, the firm using it is responsible for seeing that this requirement is fulfilled, but the seller, hirer or agent of a machine not complying with these requirements is guilty of an offence with penalties (that is, a fine of anything up to £100).

This requirement does not apply to machinery constructed before July 30, 1937, or to machinery of which the construction was begun before that date.

Self-Acting Machines, Sumps, Pits, Vessels

The traversing carriage (and any materials carried thereon) of any self-acting machine (*e.g.*, rack saw bench) must not be allowed to run (inward and outward traverses) within a distance of eighteen inches from any fixed structure not being part of the machine, if the space over which it runs out is a space over which any person is liable to pass. This requirement applies to factories erected after December 31, 1895; also to any factory reconstructed and to any additions or extensions made after July 30, 1937.

If a fixed vessel, structure, sump or pit of which the edge is less than 3 ft. above the adjoining ground or platform contains any scalding, corrosive or poisonous liquid, it must either be securely covered or fenced to at least that height. If, owing to the nature of the work, this secure covering or fencing is impracticable, all practicable steps must be taken by covering fencing or other means to prevent any person from falling into the vessel, etc.

Lifting Machinery

The provisions concerning hoists and lifts, chains, ropes and lifting tackle, and cranes and other lifting machines, have been detailed, included in the Act and made general to all trades, whereas formerly these applied to different trades by Regulations. These provisions apply to both makers and users according to the provisions laid down. The requirements are very comprehensive, but space forbids details.

Floors, Passages and Stairs

A new section arising from the Report of the Committee on Accidents requires all floors, steps, stairs, passages and gangways to be of sound construction and properly maintained. Hand rails must be provided for staircases, all openings in floors securely fenced, and all ladders must be soundly constructed and properly maintained.

Steam Boilers

The requirements concerning steam boilers and accessories such as safety valves, stop valves, pressure gauges, water gauges and so forth are laid down in more detail. Considerations of space forbid details, but the following are new provisions. Where there is more than one boiler, a plate bearing a distinctive number must be attached to each boiler; this does not apply to economisers and superheaters.

Special precautions must be taken before a person is allowed to enter or be in any steam boiler which is one of a range of two or more boilers. Every steam boiler must be examined by a competent person once in every fourteen months and always after any extensive repairs. Details of the examination to be made are laid down in the Act, this giving of details being an amplification of the former provision. A report of any such examination must be attached to or entered in the General Register, and 28 days is now allowed for this entry to be made, instead of fourteen days as formerly obtained.

Economisers and superheaters are now included in the definition of steam boilers. A new provision gives power to the Chief Inspector to except (by certificate) any class or type of steam boiler from any of the requirements laid down, and any such exception may be unqualified or be subject to such conditions as may be contained in the certificate. This power is also given in respect of the new provisions which concern steam receivers and steam containers and air receivers.

Fire-Escapes

Proper means of escape in case of fire must be provided, and existing law has been much extended and new provisions also introduced. The requirements will apply to smaller establishments, factories with 21 employees and upwards coming within the obligations, whereas formerly the rule only applied to factories with 41 employees. Furthermore, as regards factories constructed after July 30, 1937, the requirements will apply to premises where at least 11 persons are employed on any floor above the ground floor, and for factories completed before July 30, 1937, the provisions apply if 11 persons or more are employed above the first floor or more than 20 ft. above ground level. Where explosive or highly inflammable materials are stored or used, the obligation applies irrespective of size of factory or number of employees.

A new provision lays down that, where more than twenty employees are employed above the first floor or more than 20 ft. from the ground level, or where explosive, etc., materials are stored or used, employees must be instructed concerning means of escape and the routine to be followed in case of fire. Regulations will be

(*Continued on page* 364.)

Compressed Air in Automatic-Loom Manufacture

By J. WALSH

During a recent visit to Blackburn, the writer spent some time in the Daisyfield Works of the British Northrop Loom Company, Limited. This firm is well known as one of the largest manufacturers of automatic looms in the world, producing machinery for every kind of textile fabric from the coarsest to the finest. Examples illustrating the wide range of machinery were seen in the experimental and demonstration room, where there were looms weaving such fabrics as tyre canvas, sailcloth, towels and blankets, whilst at the other extreme the finest linens and silks were being made.

It is not proposed to enter into a detailed description of the highly-intricate products of this factory, but it might be mentioned that all the looms are of the automatic type, which require practically no attention once they have been put into operation. This means, in effect, that one operator can look after no less than 24 to 48 machines, against only 4 to 6 hand looms, such as are still largely used in this country.

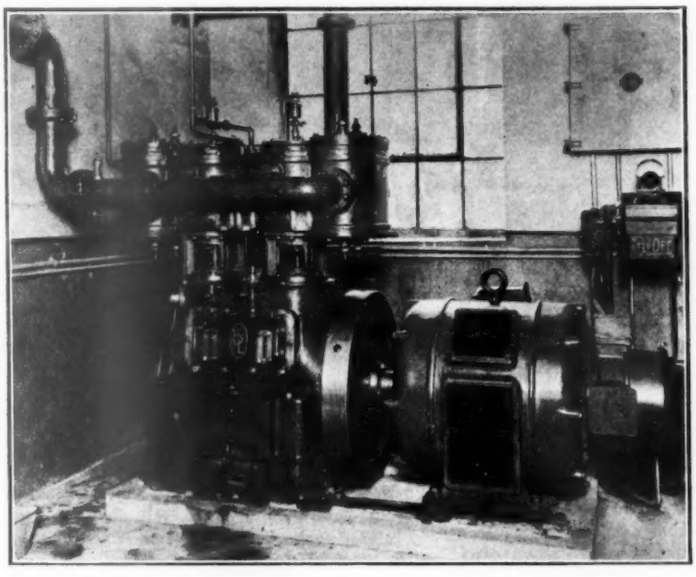

FIG. 1.—BROWETT-LINDLEY SINGLE-STAGE MOTOR-DRIVEN AIR-COMPRESSOR INSTALLATION AT BRITISH NORTHROP LOOM COMPANY'S WORKS.

Lay-Out

The shops are accommodated in two large main buildings. The first and older portion consists of four floors and a basement, housing machine shops, sub-assembly departments and stores. The newer portion contains the main machine shops, assembly departments, foundry and patternshops. The present foundry building* dates from 1935, and in common with the machine shops, has been greatly extended during the past year.

Throughout the growth of the company since its formation in 1906, an increasing use has been made in the various departments of compressed air, until now there are many hundreds of compressed-air "points," and there is scarcely a manufacturing process in which it does not enter. The greater part of the air is used at 35-lb. pressure, and is produced by the new Browett-Lindley single-stage motor-driven machine illustrated in Fig. 1, which was installed late in 1937. This is of the totally-enclosed forced-lubricated "crosshead" type, in which the cylinder lubrication is arranged separately from that of the motion work. The construction ensures economy of oil consumption and enables the outlet air to be maintained free from contamination.

There are also several small air-cooled three-cylinder machines, which supply air at 100 lb. per sq. in. for certain purposes. These were installed some years ago, and will probably be replaced in the near future by more modern plant. All the compressor plant is situated in a light, well-arranged power house with its receivers in the newer part of the works, where the greatest use of air occurs.

The Foundry

On entering this foundry, one's first impression is that the lighting and ventilation are unusually fine. A unique feature which must be particularly appreciated by the workpeople in summer weather is the sliding roof. Several interesting uses of compressed air are made in this department, including two rotary-table shot-blast machines shown in Fig. 2, and more than thirty automatic moulding machines. The moulding machines deserve special mention.

Two main types are in use, known respectively as the jolt-press and roll-over machines, manufactured by J. W. Jackman & Company, Limited. The general construction of one of the former machines can be seen in Fig. 3, the sequence of operation being as follows:—

The moulding box is placed on the table and sand is shovelled around the pattern. The operator then brings into action a knee-valve (see Fig. 3), which admits air to the underside of a piston connected to the table. Jolting thus takes place at high speed, and the sand is thereby rammed into intimate contact with the pattern. After a short period of jolting, the upper layers of sand are pressed or "squeezed" by lowering the balanced presser head (seen above the moulding box) into position over the box and operating a hand lever. This causes air to be admitted to the piston so that the whole box is raised against the presser head. All hand ramming is thus eliminated, and by means of a special release valve the pressure of ramming is the same for every mould irrespective of any slight differences in the supply.

The pattern is withdrawn by hand, the pattern-plate being vibrated at the same time to facilitate this operation. Another knee-valve (shown to the left of that in use, in the illustration) controls the vibrator so that the moulder has both hands free for the lifting of the moulding box. It was stated that an experienced moulder could make no fewer than 100 moulds per day to an average size of 12 in. by 12 in. with one of these machines.

In the roll-over jolter, for somewhat larger castings there is a similar action, but no final squeeze as in the machine described above.

The ingenious vibrators referred to consist of a small cylinder, forming part of the pattern-plate, in which a loose piston flies rapidly to and fro when air is admitted. By this means a vibration is transmitted to the pattern which dispenses with the necessity of rapping with a hammer whilst it is being withdrawn.

Machine Shops

Compressed air is also used to a great extent in the main machine shop for operation of automatic pneumatic chucks, swarf-blowing, etc. There is a battery of Potter and Johnson automatic lathes equipped with pneumatic chucks, and Herbert capstan and turret lathes and Warner and Swasey turrets with the same device. The milling machines are equipped with air-vices and practically all the machines are fitted with a swarf-blowing device or "duster." These consist of a special venturi nozzle conveniently arranged in a pistol grip and designed to give high-velocity air blast which is brought into action by a trigger. There are also a number of portable compressed-air drilling machines in this department.

FIG. 2.—ROTARY-TABLE SHOT-BLASTING MACHINES INSTALLED AT THE DAISYFIELD WORKS.

Assembly Departments

In the main assembly departments, the majority of the portable tools such as grinders, drilling machines, riveters, etc., are driven by compressed air; air-vices are also being installed. In the various "unit" or sub-assembly departments air-vices are almost exclusively used because of the immense saving in time which

* See FOUNDRY TRADE JOURNAL, Vol. 53, pp. 333-4.

results. Fig. 4 shows one of the work benches equipped with such vices. Air is brought down to bench level in a horizontal pipe from which connections are taken off at intervals for the vices. Each vice is equipped with a pressure gauge so that the fitters can be sure that the equipment is working properly.

General

It will be seen from the above that, in common with many other modern factories, the British Northrop Loom Company are distinctly "air-minded." In fact, air connections are provided almost everywhere, in a similar manner to electricity "points." All air-pipes are painted yellow throughout the works so that they can easily be traced for maintenance and additions. Great care is taken to ensure the efficiency of the supply by regular tests of the various air-consuming appliances and of the air-pipe system.

It may be asked why such extensive use is made of air tools when at first sight electricity would appear the more suitable and efficient power medium. The answer is twofold: compressed-air power is usually much simpler to apply, with consequent savings in capital and operation costs. Secondly, conditions in most engineering shops are not such as to ensure the most intelligent and careful usage, so that the simpler and more robust air tools stand up for longer periods, with less cost in maintenance. This particularly applies to portable grinding and drilling machines, for whereas an air tool of this kind can be persistently jammed and overloaded without undue harm, the same treatment of an electrically-driven tool would very soon burn out the motor. As far as power costs are concerned, there is very little difference between the two systems.

In conclusion, the writer wishes to acknowledge with many thanks the facilities given in connection with the preparation of this article by various officials of the company, and in particular by Mr. H. G. King, M.I.Mech.E., M.I.Loco.E., the works director.

FIG. 3.—JOLT-PRESS MOULDING MACHINE PRODUCING MOULDS FOR LOOM CASTINGS.

FIG. 4.—VICES ACTUATED BY COMPRESSED AIR USED IN SUB-ASSEMBLY.

Catalogues Received

Steel Castings. There is just one feature of an otherwise excellent brochure dealing with "K.L. Stronger Steel," issued by Kryn & Lahy (1928), Limited, Letchworth, Herts, to which exception can be taken, and that is the correlation with published specifications as means of stressing the quality of their "K.L. Stronger Steel" castings. Specifications are issued giving only the *minimum* requirements, and as such do not provide a fundamentally sound basis for comparison. It would have been better to state the properties of the ordinary run of steel castings and build up the argument from that premise. The general plan of the brochure—after a plain statement of the properties of the steel—has been to reproduce two typical test-room reports and then to illustrate the ultimate application and particular use of steel castings. A tube train and its wheels typify this aspect. This gives full fling to the art of publicity, and maximum advantage has been taken of it. The photography is excellent; the reproductions beyond reproach, and our congratulations are offered to those responsible. It has well fulfilled its object of instilling confidence in the ability of the firm to supply the highest grade of carbon steel castings.

Bearings. An eight-page booklet received from the Phosphor Bronze Company, Limited, of 54, St. Thomas Street, London, S.E.1, describes and illustrates the "Bound Brook" oil-less range of bearings. These are bronze castings made in the form of an accurately-machined bush and carrying either cast-in or machined grooves. These grooves are then filled in by hydraulic pressure with a special graphite composition. After a heat-treatment they are finish-machined. They are specially designed to operate where slow speeds and heavy loads are encountered.

We want to take this opportunity of correcting an error which we made when reviewing a catalogue received from this firm in our issue of March 24. We stated that the major use for "Compo" oil-retaining bushes and bearings was for domestic appliances, but actually their chief employment is in the motor-vehicle industry.

Wear and Tear Allowance

BUDGET CONCESSION

The Chancellor of the Exchequer announced in his Budget speech last week that an increased allowance for wear and tear of machinery would be granted during the forthcoming year when assessing the profits of trade for income-tax purposes under Schedule D. For wear and tear of machinery and plant used by practically all trades there are agreements between the Board of Inland Revenue and the various trade associations as to the rates to be allowed, subject to sanction by the General or Special Commissioners concerned in the assessment. The rates were raised by 10 per cent. for the year 1932-33 and onwards. The additional allowance is now to be 20 per cent., instead of 10 per cent.

The Chancellor announced an increase of the standard rate of income tax by 6d. to 5s. 6d. The Customs duty on light hydrocarbon oils and on heavy oil used as fuel in road vehicles has been increased by 1d. to 9d. per gallon, and an Excise duty of 9d. per gallon is being imposed on power methylated spirits as from May 2.

The New Factories Act—II

(*Continued from page* 362.)

issued giving details of steps to be taken. Under these fire-escape provisions, a certificate is required from the local council, and it should be noted that a new certificate is required, after July 1, 1938, even though one under existing law is in the possession of the firm concerned.

Machinery Cleaning

Women and young persons are prohibited from cleaning any part of a prime mover or transmission machinery while in motion, and must not clean any part of any machine if the cleaning would expose the cleaner to risk of injury from any moving part of that machine or of any adjacent machinery. A new provision prohibits any young person working at certain machines unless instruction has been given concerning the possible dangers, the precautions to be observed, and unless such person has received sufficient training in work at the machine, or is under adequate supervision by a person who has a thorough knowledge and experience of the machine. Regulations will specify machines coming within this provision.

Protection of Eyes

Where there is a process which may involve a special risk of injury to the eyes from particles or fragments thrown off in the course of the process, suitable goggles or effective screens must be provided to protect the eyes of the persons employed in the process. The processes where these obligations will apply will be specified and directions concerning them given in Regulations to be issued.

Modern Methods of Sand Testing

We printed on April 21 a Paper on "Modern Methods of Sand Testing," which Mr. Wm. Y. Buchanan delivered before the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen.

Following the reading of the Paper, a vote of thanks to the author was proposed by MR. J. J. SHEEHAN, who expressed admiration of Mr. Buchanan's courage in presenting such a controversial Paper in Birmingham, as the Branch had a number of its members on the Sands Sub-Committee of the Technical Committee of the Institute. There were certain points in the Paper which he would discuss later, but he wished to pay a tribute to the trouble Mr. Buchanan had been to in preparing the data for his Paper and the excellent way in which it had been put forward.

MR. A. TIPPER seconded the vote of thanks, which was accorded unanimously.

Combination of Test Methods Suggested

MR. W. B. PARKES, who opened the discussion, said that Mr. Buchanan had shown that differences in the strength between short and long test-pieces of the same apparent density were of the order of 50 per cent. in the case of a sand with a strength of 2 to 3 lbs. per sq. in. In the case of stronger sands, was the error still 50 per cent., or did it remain in the region of 1 or 2 lbs. per sq. in.? With regard to the use of index of ramming and A.F.A. methods together, had Mr. Buchanan any results showing tests made by the two methods on test-pieces of the same length, uniformly rammed? With differences of 50 per cent. due to shape of test-piece and method of ramming, conclusions drawn from a comparison of the results obtained by the two methods might be misleading. Provided the difficulty of the test-pieces could be overcome, a combination of the two methods would be most useful, the A.F.A. method being used to obtain the combined effect of all the variables—moisture content, clay content, flowability and grain distribution—and the index of ramming method to determine each variable separately. This would be simple in the case of moisture and clay content, but how did Mr. Buchanan propose to make the comparison in the case of variation in grain distribution, which could not be represented by a single number and for which a very large number of curves would be required, even in the simple case of a red sand from a single deposit with normal variation in grain distribution from place to place?

MR. BUCHANAN, in reply, said that the tables gave figures and errors at various green strengths; the errors varied a great deal, due to combined effects. First he had used the A.F.A. and the 2½ in. by 1½ in. tests. Later, he had done the work on the standard A.F.A. and 2 in. by 2 in. double-compression by index of ramming 13. There was, as shown, an error in the A.F.A. test, due to uneven ramming, of 10 per cent., not 50 per cent., and if this were corrected it would make the difference between the graphs even greater, *e.g.*, Fig. 8. It would not alter the angle of the curve, however. The test-pieces could be made uniform, but the standard A.F.A. method would have to be altered first of all by the Committee responsible, as suggested in his recommendations.

The possible variations of grain distribution were, of course, endless, but they could be tested by the index of ramming just as simply as by the A.F.A. test. The former would give the effect of whatever variation there was, while the latter would give the same result confused with the flowability of the A.F.A. test-piece.

MR. TIPPER asked the lecturer if he recommended that the index of ramming should be obtained for each sample of sand before it was tested.

MR. BUCHANAN replied that, in the B.C.I.R.A. system of testing, the index of ramming would simply be substituted for the green apparent density of the test-piece. In the A.F.A. test the moisture content of the sand influenced the results obtained on all the tests, due to the influence of flowability. Tests obtained using the index of ramming method were independent of the influence of water and flowability.

American Methods Upheld

MR. SHEEHAN said that he thought that the lecture might confuse many people by suggesting that methods of testing were being compared. The A.F.A. methods had been devised after a considerable amount of work, as practical tests to assist the founder in controlling his sand. The methods described by Mr. Buchanan were, in his opinion, more useful for the research worker in the laboratory. The methods of testing should not be compared, and there should be no argument as to their respective merits, as the type of test which could be used to advantage in the laboratory was not necessarily suitable as a control test in the foundry. The best percentage of moisture for any sand was that which would give a good workable sand. When the best results to be obtained from a certain sand had been found, it was possible to control this, within fairly narrow limits, by the use of the A.F.A. apparatus. This apparatus could be easily applied with little trouble by relatively unskilled labour. The tests recommended by Mr. Buchanan were, in his opinion, too scientific for use in the average foundry. In other words, he appreciated Mr. Buchanan's work, but deprecated his arguments.

Mr. Buchanan had said that the A.F.A. test-piece was hard on the outside and soft in the middle. He would remind him that this was true of any mould, however rammed. The only way to get a perfectly homogeneous ramming was to place each grain of sand separately in the test-piece. He thought there was a possibility that founders might be led astray by too much scientific care in sand testing.

A Better Understanding Sought

MR. BUCHANAN said that the methods were certainly being compared, as that was part of the object of the Paper, and they were continually being compared in this country by every new worker in sands. The proposed methods were intended for the study of sand in the foundry, and to help towards a rational understanding of the principles of daily practice. Much of the work already done by the A.F.A. test was satisfactory. He was not arguing against control tests if they were used merely to show changes from one lot of sand to another. Mr. Sheehan had not understood the intention of the speaker—the index of ramming was to be additional to the A.F.A., but first the errors of the A.F.A. must be pointed out.

The ramming obtained by squeezing *was* homogeneous for all practical purposes, but the A.F.A. method showed such a lack of homogeneity as to result in serious errors. On the contrary, founders had been led astray by the want of scientific care which was usually conspicuous by its absence.

There was no question of trying to oust the A.F.A. tests. He recommended that the index of ramming should be additional. He had shown that the A.F.A. tests had certain limitations and, in his opinion, in the future sand testing would require to be put on a more scientific basis. He agreed that moulds, like A.F.A. test-pieces, as made by the normal methods, were harder on the top than inside, but he wished to remind Mr. Sheehan that, in testing sand, one wished to measure properties and not to test pieces like miniature moulds. One would not, for example, refuse to analyse a large consignment of pig-iron because one knew that there were variations in composition in different parts of the consignment. In order to obtain a reliable analysis of such a consignment, it would be necessary to ensure that great care was exercised in obtaining a truly representative and uniform sample, and he considered that this was equally important in obtaining a test-piece of a moulding sand. If the choice were available between a uniform and a non-uniform test-piece, surely it was advisable to choose the former. The index of ramming method allowed a comparison to be made of all sands, irrespective of their type. For example, a sand used in the Midlands could be compared with one used in Australia, and this was not possible using the A.F.A. methods, unless flowability was to be included as well as the errors now existing in the A.F.A. test-piece.

"Elastic" Sands

MR. J. G. PEARCE said that he wished to pay tribute to Mr. Buchanan for his ingenuity and the thoroughness with which he had carried out his investigations. It was difficult to find an analogy between sand testing and any other type of test. In some respects the testing of sand was similar to tests for heat, corrosion and wear, carried out on cast iron. In such tests it was not possible easily to reproduce working conditions in a rapid test, but it was necessary to reproduce working conditions as near as possible if a reliable result was to be obtained. The position might be likened to that of a man who had to decide between buying a cheap ready-made suit, which might not fit him perfectly, but which could be obtained immediately, or waiting for some time for one to be made by a first-class tailor, the latter also being considerably more expensive. For routine testing he thought there was little choice, because often in the average foundry an untrained boy was given the job of taking records. He thought that Mr. Dietert's use of the term "resilience" was correct, and this was the property possessed by material for storing energy under stress. Sands were, of course, not obviously elastic, but he would be surprised to learn that they were totally inelastic. Recent work had proved that cast iron was to a large extent resilient, and in the transverse test only 20 per cent. of the total stress up to the point of fracture was absorbed by the material; the other 80 per cent. was given out when the load was discontinued. With sand it was probable that a considerable amount of the energy would be absorbed, but no doubt some small amount would be again given out when the load was removed.

MR. BUCHANAN said that in his experience sands had very little resilience. The amount of deformation was very noticeable, but he had not found it possible so far to measure any resilience. He had found evidence of resilience in *ramming* the A.F.A. test-piece, which explained why drop-weight rammed tests were harder than compressed tests of the same weight—but no evidence of resilience in *actual testing*.

Not Suited to Routine

MR. J. HIRD thought it possible that the air entrained in the sand might give it a slight resilience. He would like to know if the methods put forward by Mr. Buchanan were recommended for use in the foundry, or purely for academic research. The sand used in the average foundry had additions of coal-dust and increasing amounts of silt from day to day, and it would appear that if Mr. Buchanan's tests were to be used, it would be necessary to calculate the new density of the sand daily. He could not see that Mr. Buchanan's tests could be applied in the average foundry.

MR. BUCHANAN replied that the method would not necessarily be used for rapid routine tests

It could be used for that purpose, but this would require further explanation. Where the density of sand varied, the density would have to be determined, *i.e.*, if it could not be obtained by calculation or from published figures. Coal-dust would alter the density, but silt would not. The method was really most useful in the manner in which it had been used in the Paper—to chart the effect of variables on sand and then use the A.F.A. test to control these variables.

The main objection in the U.S.A. to the measuring of test-pieces by weight was that density of sands varied from one district to another. This was taken care of in the index of ramming. He thought that the A.F.A. tests would probably remain the accepted routine test, but he was convinced that anyone who wished to make a thorough study of sand would find the limitations of the A.F.A. apparatus and method of making the test-piece.

He agreed that air entrained between the sand grains would have a cushioning effect, and so give the sand a certain amount of resilience *in ramming*, but not, of course, in the deformation test. He also said that as he had a foundry to look after, his point of view could not be called academic.

Density Calculation

MR. J. H. DOLPHIN asked Mr. Buchanan how he would obtain the density of a sand containing 15 per cent. coal-dust.

MR. BUCHANAN replied that he would do so by calculation of density. If the operator could not do this, then he could not, of course, use the method.

MR. J. W. GARDOM said he thought that there was one point which might have been lost sight of during the discussion. He would like to ask the lecturer whether sand testing had helped any foundry to produce better castings.

MR. BUCHANAN said that the tests he suggested were, in his opinion, really necessary to obtain fundamental knowledge on sand testing. There was no doubt at all about the value of sand tests, but Papers written on the subject often contained what could be proved to be false conclusions, owing to the method of testing adopted. They used routine tests on what was really research, and the results obtained could mislead others. In his own case, within a few weeks of sand testing being inaugurated, the expenditure on sand had been reduced. This had been the experience of a large number of founders. Defects were often difficult to trace, and routine tests did not fill the necessity for a proper understanding of the factors involved.

United States Output of Pig-Iron and Ferro-Alloys in 1937

According to Statistical Bulletin No. 1 (April, 1938) of the American Iron and Steel Institute, the production of pig-iron and ferro-alloys in the United States in 1937 totalled 37,127,277 gross tons, as compared with 31,029,187 tons in 1936, 8,781,453 tons in 1932, and 42,613,983 tons in 1929. The number of blast furnaces in operation on December 31, 1937, was 95 out of a total of 241, as against 187 on June 30, 1937, and 176 on December 31, 1936.

By grades, the pig-iron output in 1937 (1936) included 24,780,789 (20,476,921) tons of basic iron, 6,315,382 (5,876,762) tons of Bessemer and low-phosphorus iron, 2,826,238 (2,030,991) tons of foundry iron, and 2,115,106 (1,717,057) tons of malleable iron.

The year's output of ferro-alloys totalled 997,681 (812,640) tons, and included 515,781 (395,119) tons of ferro-manganese and spiegeleisen, 412,432 (360,490) tons of ferro-silicon, and 69,468 (57,031) tons of other ferro-alloys.

Temperature Measurement of Molten Steel

In conjunction with researches into the nature of the physico-chemical processes in the basic open-hearth furnace carried out for the steel-works committee of the Verein deutscher Eisenhüttenleute, it was found necessary to measure the temperature of the molten steel with a high degree of accuracy. Optical methods of measurement were considered too uncertain for the purpose in view, as their readings are closely dependent on variations in the emission coefficients of the more or less oxidised surface of the liquid steel. As described by G. LEIBER in Report No. 328 of the committee, published in

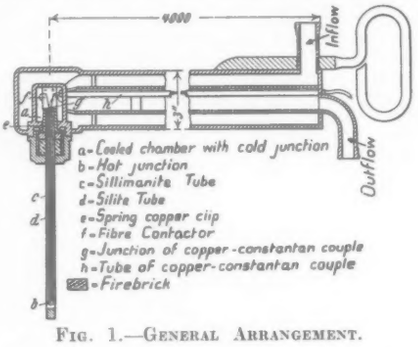

FIG. 1.—GENERAL ARRANGEMENT.

the "Archiv für das Eisenhüttenwesen," a measuring arrangement was therefore evolved based on the use of the tungsten-molybdenum thermocouple, which proved to be exceptionally reliable and permitted continuous measurements to be made with very great accuracy.

The general design of the measuring arrangement is shown in Fig. 1. It consisted essentially of a water-cooled tube 4 m. long, with the thermocouple at the front end. The cold junction is accommodated in a chamber cooled by a current of cold water, the temperature of this junction being measured by a copper-constantan couple, whose cold junction, connected to a millivoltmeter, is located in a tube through which cold water is circulated. To enable the thermocouples to be changed rapidly, a contact unit has been incorporated into which the cold junction of the W-Mo couple is plugged. Between the poles of these terminals the hot junction of the second couple is situated.

The W-Mo couple is protected by an inner sillimanite tube and an outer silite tube, which gives a high durability. The sillimanite tube is secured at the top by a spring clip made of copper, which also ensures satisfactory dissipation of heat. The silite tube is closed at one end by a plug of high-grade fireclay. Before immersion of the thermocouple into the molten steel, it was preheated to ensure rapid temperature equalisation, a measure which also protects the silite tube. In this way three measurements could be made with each protective tube. If this tube or the thermocouple is damaged, the defective parts can be changed in a few minutes.

The method of measurement is shown diagrammatically in Fig. 2. The thermo-voltage generated at the hot junction A of the W-Mo couple is indicated by the millivoltmeter I; at the same time the temperature of the cold junction of this couple is measured by the second couple. The thermo-voltage of the second couple is read off on millivoltmeter II. The calibration curve of the second couple is linear and gives the temperature difference between its hot and cold junctions, the latter being at cold water temperature which was measured by a mercury thermometer. The water temperature and the differential temperature of the second couple give the temperature of the cold junction of the W-Mo couple, while its hot-junction temperature is measured directly. A measurement thus consists of three readings: the thermo-voltage of the W-Mo couple, the thermo-voltage of the copper-constantan couple, and the temperature of the cooling water. Suitable corrections are made from correction and calibration curves. All thermocouples were made from the same batch of W-Mo wire and showed no measurable difference in thermo-voltage. The wires were 1 mm. thick.

The arrangement was tested by a long series of measurements and very consistent readings obtained. It appeared that the errors were much smaller than the temperature fluctuations in the molten steel. Readings were also compared with optical measurements of the surface temperature, which enabled the temperature conditions at and below the surface of molten steel to be compared. The emission coefficient was deduced from these parallel measurements and it was found to be independent of the appearance of the molten-steel surface. If the surface is predominantly dark a mean emission coefficient of 0.445 is found, while measurements of the temperature of the slag surface on changing over indicated that the radiation of the furnace hearth approximated to that of a black body, being only slightly less than unity.

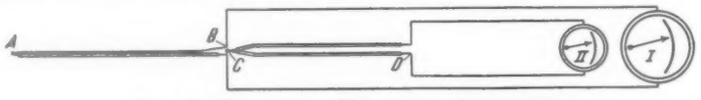

FIG. 2.—LAY-OUT OF MEASURING ARRANGEMENT.

A—Hot junction of W-Mo couple. B—Cold junction of W-Mo couple. C—Hot junction of Cu-constantan couple.
D—Cold junction of Cu-constantan couple, at temperature ofcooling water. I—Millivoltmeter for W-Mo couple.
II—Millivoltmeter for Cu-constantan couple.

Notes from the Branches

Lancashire Branch Junior Section. — The annual whist drive, social and dance of the Lancashire Junior Section of the Institute of British Foundrymen was held in Manchester recently. The function was well supported by the members of the Lancashire Branch, whose ordinary monthly meeting terminated slightly earlier than usual in order to enable them to attend.

Lincoln Section.—The Lincoln Section of the Institute of British Foundrymen held its annual general meeting in Lincoln on April 4. A record number attended, and great interest was taken in the moulding competition by students of the Foundry Class under Mr. E. C. Carrott (prizes for which were kindly given by the management of Ruston & Hornsby, Limited, and Mr. T. Mather). Light refreshments were served after the meeting.

The SECRETARY (Mr. E. R. Walter, M.Sc.) reported that the Section was keeping up its strength and the average attendance at all meetings had increased considerably. The retiring CHAIRMAN (Mr. F. Dunleavy) called attention to the fact that the last winter programme compared favourably with any of the Branches, having included six Papers by men acknowledged to be specialists in their particular subjects, and appealed for increased membership, with the result that several new members were obtained.

Mr. G. L. Harbach, on the proposal of the CHAIRMAN, was elected President for 1938-39, and Mr. E. C. Carrott and Mr. H. E. Cavill were elected respectively Senior and Junior Vice-Presidents. The remaining members of the Committee, together with Mr. Gladwell and the Secretary, were elected *en bloc*.

Following the general meeting, MR. GLADWELL read a Paper on "Some Repetition Methods of Moulding."

Estimating, Costing and Accounting*

By W. H. WHITTLE (Chairman of The Institute of Vitreous Enamellers)

It is common knowledge that estimating, costing and accounting are very controversial matters. The author has searched for many years now to discover any articles written upon the subject, particularly relative to the vitreous enamelling industry. One of the best so far discovered is by J. E. Hansen, and what follows is a commentary upon the points he puts forward.

For the purpose of the Paper it will be assumed that a cost system, more or less progressive and accurate, is available, and that it compiles costs of products or operations. The problem then becomes one of making the best use of those records, and expands them as the basis for controlling and directing future operations. Before going further with the point, one may divide vitreous enamelling works, or classify them, into two or three types. The first type would be a simple enamelling works which would buy blanks and enamels for re-sale, or incidentally might do a business in vitreous enamelling only. The second type would be a works which manufactures enamelled products. This type of plant buys its raw material, makes certain definite blanks, enamels, and sells them. Hollow-ware plants, some of the sanitary-ware plants, and most of the sign plants are included in this class. The third type includes shops which are a part of other industries. Under this group are shops producing parts which are assembled later into complete products, such as cookers, refrigerators and the like.

Three Systems Required

Each of these three classes calls for a different method of accounting, and all three may be further complicated when such activities as frit making, gas producing, and sheet metal work are added to the operations.

There are several general schemes of cost accounting. First of all, there is the job order system. Under this method, costs are accumulated to a particular lot of articles. This system is used in job shops, and often in other types of manufacturing. It is intended to deal with production of pieces which are not produced in regular lots or at regular intervals. In the enamel industry, sign-shops quite generally use this system.

The prevailing method of accounting for such work consists of establishing an order number and accumulating the costs of producing this lot against that number. For example, let it be assumed that 1,000 signs in various colours are in Lot 20. There would be an entry in the cost ledger something like this:—The weight of the metal; the frit used; the ground coat; the white; and so on, and, in the case of black, there would be the tin oxide and the black oxide. As far as labour is concerned, there would be an item for cutting and punching, pickling, enamelling and brushing. This would give the costs of the total, and it would be divided by the number.

The Unit Cost System

Secondly, there is the unit or monthly scheduled cost. This is essentially the same as the job-order system, except that each month's production is carried as a separate account. In this method no attempt is made to keep each lot separate. The entire production for each month is thrown together and an average is secured.

Thirdly, there is the process method of accounting, such as used in frit making. In this method, the materials and labour are charged to the department and the total cost of running the department is divided by the number of pounds of finished product. It would be as well for many enamellers to analyse their method of process accounting, as on looking into the matter it will be found that they usually omit some factors of both direct and indirect cost.

Another point is one which has actually occurred in getting out a schedule. One knows exactly, within reason, what a job should cost. There is a little trouble with the enamel, and an outside man is consulted and he possibly advises the use of a little more or a little less clay according to the particular circumstances of the case. For instance, in regard to opacity, he may advise reducing the clay by 1 per cent. and increasing the oxide of tin by 1 per cent. This alteration does not sound very much when overcoming a passing trouble. Clay is one of the cheapest articles used, being about one-third to one-quarter the price of frit; so the more clay put in, within reason, the cheaper the frit. Each 1 per cent. of oxide of tin added increases the price by 2s. a cwt. or £2 a ton. If a few tons are being used per week, at £2 a ton, the user will begin to wonder what is happening. This was an occurrence which had actually happened, and therefore it was essential to check periodically.

Standard Costs

Fourthly, there is the most recent system of cost accounting—the standard cost.* This method affords control of operations. The basis for any system of standard costs is accurate, pre-determined standards, such as cost of spraying per sq. ft., cost of enamel per sq. ft. for a given shape, cost of pickling per sq. ft. or per piece, and cost of packing per piece.

Assuming a standard cost was being prepared for a crown plate, door or panel, the following facts must be known. (1) The size of the blank from which the piece is formed; (2) the amount of enamel per sq. ft.; (3) standard time or piecework prices for all operations, and (4) rate and method of overhead application. These standard costs are not accurate estimates; they are the forecasts of what it should cost to make the products. In this respect, they are better than other types of cost figures, because they enable the plant to avoid unprofitable orders.

Where Losses are Incurred

In the jobbing trade in particular, one is asked to take almost any kind of job. With profits at their present small margin, it is essential to ensure that each job or order earns at least some profit, while for special work it is essential that a firm should receive more than the general return upon ordinary commercial work. For instance, a competitor is using muffles which will only take, say, work up to 1 ft. 9 in. or 2 ft. high. It is costing much less to run those muffles than in the case of another works which has a 2 ft. 6 in. or 2 ft. 9 in. high muffle.

In the general run of jobbing, it will be found that with most of the average work that comes in, it will go in the smaller muffle. There is always the continuous charge of 6d. to 1s. an hour more for fuel on the higher or larger type of muffle, merely to deal with the few jobs which come along periodically and for which the customer should pay more. A similar consideration obtains when handling heavier jobs and perrits have to be removed, etc.

This is rather departing from costing, but it enters into estimating. A job is proposed for which a price is required. If it is the ordinary commercial job, it will be quoted for size and weight per pound; but when it is a job in connection with which it is necessary to consult the heads of departments, and even the management itself, the firm has lost on that job initially because it has taken attention from the main line of business in regard to repetition work, etc., and it is necessary to get a little more than the ordinary commercial price.

Earning a Profit

Some attempt must be made to discover which are unprofitable orders; an estimate must be made of the cost of any product. It can easily be done if a careful study is made of the following elements which enter into the cost of producing vitreous enamelled goods:—(1) The weight of the metal, including waste in trimmings, or how many blanks from a sheet; (2) weight of each coat of enamel used per sq. ft. or per lb. of production; (3) labour cost of shaping or casting the metal; (4) labour cost of applying the enamel, and (5) cost of packing. Various other costs such as heat, maintenance of plant, supervision, and scrap, should be included in the overhead costs.

These details can be obtained with a fair degree of accuracy in almost any plant. Piecework prices will often determine labour costs without further trouble. Pounds of enamel used, divided by sq. ft. of production, will give a rough figure on enamel. Square footage of enamel will serve to calculate cost and weight of base.

If one does not care to use this system of estimate-standard type of costs alone, one can use the old method of time tickets and material requisitions to show a record of the cost of each job. This same system may be used with charges against a particular piece number to give monthly costs of piece parts. Either of these methods may be used to check the standard costs, if the estimates do not seem to be sufficiently accurate. In fact, many concerns use standard estimates of costs and follow up with a detailed actual cost to check the standard, and to serve as a basis for general accounting records.

The question naturally arises as to what value are these figures if only the accounting department makes use of them. They are of little value until the factory organisation has been trained to analyse and use them. For this purpose, simple reports to the department involved would do.

Control of Budgeting

Some people are fond of what they term control by budget. The subject of budgetary control is becoming more important to every operating

* Paper read before the Northern Section of The Institute of Vitreous Enamellers.

* See J. W. G. Pedder, FOUNDRY TRADE JOURNAL, Vol. 56, pp. 196-8.

man. In former years, budgets were something for accountants to use and managers to wonder about. To-day, most businesses which even pretend to control their financial affairs base their operation on some sort of budget. It could, of course, even be used in jobbing places, although it is more for the firms which have standard production. Nevertheless, a jobbing works could find approximately the weight of output it could undertake and make efforts to obtain that amount.

A budget is a definite forecast of future operations. It may concern sales, production, or finance. It may be calculated in £ s. d., units, man-hour, etc., or any other basic figure. The ordinary budget is one set up in £ s. d., referring to the financial operation of the concern for the next accounting period—say one year. In addition, sales budgets in units, and production budgets in units, are coming more into use.

Every budget must have a unit of measurement on which it is based. In a sales budget, this can be £ s. d., or sq. ft. of enamelled sheets or lbs. of castings. In production, it could be £ s. d. of product by factory cost, or £ s. d. of productive labour, or man-hours, or number of employees, or lbs. or sq. ft. produced, or any one of a number of other items depending on the use to which the budget is to be put.

After a basis has been determined, the factors to be forecast are selected. In a small business, this would probably be sales, production, production cost, sales expense, and factory expense. Three main sub-divisions will probably be made, such as direct material, direct labour and overhead. These divisions are somewhat arbitrary, but form a good way to break down costs. Before the budget can be organised, all items which enter into the cost of the product should be classified under one of these three heads.

Direct Materials

Under this classification are metal, frit and oxides. Metal requirements would be forecast by figuring the average weight per square foot and multiplying by the estimated number of feet to be produced in the year or months. This figure would then be calculated at the anticipated price per lb., or the contract price per lb., and the amount of metal cost entered in the budget.

Enamel requirements would be determined by measuring the usage per sq. ft. and multiplying by the estimated production and the forecast price. In case of uniform production of white work, tin oxide could be figured on the same basis. In case of coloured work, the average use of coloured oxides per sq. ft. for the previous year would be used. Some forecast necessarily would have to be made of the number of sq. ft. of each colour to be produced in the next year. Other materials would normally be thrown into overhead.

Direct Labour

This figure would be obtained from the average labour per sq. ft. produced during the previous period or two, with allowance for wage adjustments or increase in efficiency. As much labour as possible should be made direct. Some people, most certainly, are very apt to allow too much to come in on indirect labour. Then the firm is not getting a fair price for its article. Most enamellers know that it is, generally, the system of various firms in costing to book every man who is on time absolutely against the respective jobs he does. When it is a question of standard-wage people, such as foremen, and so forth, this does not always apply. It is quite possible a firm may bring a good foreman, or even a departmental manager, on to a job, and that he finishes it off.

Overheads

This figure would be broken into several small divisions:—(1) *Supervision and indirect labour* (which should be kept as low as possible), clerks, etc. (2) *Supplies* already allocated to a particular job, such as the cost of clay, salts, gloves, acids, cleaners and packing material. (3) *Tools*: cost of spray-guns, brushes, stones, knives, files, and other small tools, and special tools such as dies, jigs, and fixtures. (4) *Power and Fuel*: charges for electric power, water, steam, coal, gas, and any other items relating to building or furnace heat. K.v.a. is a point which is sometimes overlooked; if a firm is fortunate enough to have its own electrical supply this is one factor; but, if it buys from the power companies, these concerns generally charge on a k.v.a. basis. In the case of the works with which the author is associated, it is on that basis at the rate of about one-third of a penny per unit. In practice it operates something like this. Suppose one uses 100 k.v.a. at £4 each a year. That is £400 divided by 12 for a month. The consumption of units is charged at one-third of a penny per unit. If one can bring in night work, the cost for the k.v.a. does not repeat. That runs on, because one pays the k.v.a. on the highest number run in any period of 20 min. So the firm can run the night shift on one-third of a penny for each unit used as long as it gets it in the daytime total of k.v.a.'s. (5) *Maintenance*: Cost of all material and labour necessary to keep the buildings and equipment in repair as well as repairs for tools and machinery. (6) *Losses*: Scrap and rejects, lost time of employees on guaranteed piece rates, enamel and metal which is scrap without recourse to the supplier; also, costs of making good pieces which have been guaranteed and which fail to pass a client's tests. (7) *Fixed charges*: Taxes, insurance of all kinds, rent, compensation and royalties.

Sometimes these classifications are greatly expanded with many sub-headings. At other times they are condensed, but essentially they cover all overhead cost. It may be necessary to add a miscellaneous account, but this is not desirable.

Overhead Distribution

After the budget of expenses has been established, it is easy to develop a method of distributing overhead to the various jobs. Suppose the direct labour method is chosen. Divide the total of direct labour into the total of overhead to secure a standard rate, *i.e.*, a rate at which overhead should be applied to each job.

When a job cost is accumulated, the direct material is taken from the requisitions, the direct labour from the time tickets, and the overhead is figured as a percentage of the direct labour. If the total of the overhead applied to the orders for the month does not equal the actual expenditure, then the profit and loss account is charged or credited with the difference. If it be desired to use an actual rate of overhead each month, the monthly totals are divided to give an actual rate in the same way that a standard rate was secured.

If a rate per sq. ft. be desired, then it would be so much at a standard rate or a percentage of an actual rate. The application of overhead is a subject of much accounting discussion, and in a large business may be very important. In the smaller organisations any good principle of application can be used with excellent results. This is mentioned because of personal knowledge of very elaborate systems, the cost of which has been prohibitive to a small works; whereas with a simple system in which the principle is good, excellent results can be obtained.

Utilising a Cost Control System

The most important factor in overhead analysis is not how it is applied to orders, but how it is controlled, and how expenditures are increased or decreased to suit the changes in business volume. A well-operated cost control system supplies the management with the following facts:—(1) Accurate estimates of costs on which to base quotations for work; (2) comprehensive forecasts of operations and profits for succeeding periods; (3) adequate basis for estimates of earnings to satisfy directors; (4) rigid control of expenditures, especially at low volumes of production, when economies are necessary; (5) definite placing of responsibility for cost control and sufficient reports to make this responsibility felt; and (6) another standard by which to judge the performance of superintendents and foremen.

It can readily be seen that the management can operate departments more efficiently with figures at their disposal. Furthermore, when called upon to account for the performance of a department, such reports make it possible to explain and defend the methods of operation. Such a cost control makes it possible for supervisors to become more keen on management, and not merely to look to output irrespective of cost.

In regard to the author's particular factory, there is a record for every milling that is done, and if any record does not agree with previous ones, an inquiry is made concerning it.

A weekly sub-division of the whole of the time for all employees is made. In other words, if the wages are a given figure, it has to agree with the sub-divided amount. Thus, the metal and its fabrication are obtained quite separate. The labour costs, such as annealing, cleaning and pickling, are also quite separate, as are all the ground-coat work, all the white, spraying, swilling, laying in colours, designing, stencil cutting, fusing per ft. per fire or per pound per fire, etc. All this information is essential when estimating.

The main point of any cost system of accounting is that, whenever it is possible to allocate any charges to a particular order or department, one always does so. As people go in for larger systems, they seem to depart from this principle, and break it up, which is a mistake.

Furnace Repairs

With regard to cupola repairs and muffles, if the interest or depreciation on the capital outlay has been correctly charged, it will be in order to charge such repairs to plant account. It would enter into the overhead. If, on the other hand, interest and depreciation is not being charged, then cupola repairs become a direct foundry charge, and muffle repairs a direct enamelling charge.

Place as much labour as possible under direct labour, otherwise it will be included in the indirect labour and allow a particular job to be under-charged due to being costed incorrectly.

Hints on Estimating

In estimating, take extreme rectangular dimensions. It will be better still, if sheets are being dealt with, to see how many pieces can be cut out of a given sheet, and divide by the number cut into the area. All shapes and sizes are encountered, and it would not be wise costing to take the weight afterwards. The metal might cut out to a fair amount of scrap worth 20s. when the original cost was perhaps £20 a ton.

With regard to costing, the main thing is that statistics must come in regularly, whether daily or weekly. In many cases the system is not maintained to the extent it should be because it is "dry work." Statistics do seem uninteresting until sufficient are available. When one can compare the previous period, say, the week of the previous year or month, then they become more interesting, and they can be extended to man-hour. In the author's works the pre-war records were as £ s. d., but after the war prices varied so much that everything was calculated on a man-hour basis.

Another point is that where individual piecework is not possible, output might be encouraged by bonus and a reduction in the number of rejects effected.

In addition to ordinary costing, there must be some imagination of output. If any firm starts up a new department it cannot hope to get orders on its actual costs. It must have an imaginary output with which to fix its overheads. A firm may be only running the department at half rate. It considers that it is capable of a certain output, and as far as overheads are concerned, it proposes to divide them into the output envisaged instead of killing the job. If the

output might be equal to 500, and it is only 250, one would kill it by putting the actual overheads on to it.

In conclusion, as enamellers meet more often, they will doubtless become more and more acquainted with the problems of estimating, costing and accounting in regard to the vitreous enamelling industry; and an apt conclusion to the above are the words of Lord Dewar: "The only way to success in business is to bite off more than you can chew, and chew it; and take on more work than you can do, and do it."

DISCUSSION

The CHAIRMAN (Mr. H. Whitaker) said it was obvious that Mr. Whittle had a thorough grip of the accountancy side of his business as well as the technical side. There was a good deal to be learnt in these days. If a man could spend, say, the first 30 years of his life learning the practical side, and the next 30 years in learning the accountancy and commercial side, then he might regard himself as being fitted to manage a modern enamelling shop. Unfortunately, by that time he would probably be receiving hints that he ought to retire in favour of a younger man. They were greatly indebted to Mr. Whittle for his lecture.

Budgeting

MR. F. MURRAY (Warrington) was interested in budgeting. It was easy to ascertain the output over a period of, say, a month through the sales analysis. He was speaking, in particular, of a works like the one with which he was associated, where the enamelling was not the only part of the business. Other products were being manufactured and enamelling was merely incidental as a process. With regard to costs, the enamel ordered in one month was not necessarily used in that particular month. The cost was sub-divided by 12, and brought down to the mean of one month. If, for example, enamel costs were £24 a year, this would be at the rate of £2 a month. Then, of course, the costs should show all the overheads in a month.

Mr. Whittle had mentioned, in regard to overheads, supervision and indirect labour, the point about extra supervision. Perhaps the latter term might be applied to a case where the foreman took the spray-gun from a man's hand and proceeded to show him how the job should be done. While the foreman was doing the job, the workman was standing by doing nothing, and two people were being paid for doing the one job. He would submit that that increased supervision was already covered in overheads.

The K.V.A. Problem

Fuel could be divided over a 12-month period, but power presented a difficulty particularly if the works were on a k.v.a. basis, when usually condensers were put in for the whole of the works, unless they were run with an ammeter in series with various compressors. In some instances there might be one compressor which supplied compressed-air for moulding machines, and the same receiver supplied the air for the sand-blast. He would not venture to express any opinion as to whether the practice was good or otherwise, but he thought they would all definitely advocate separate compressors and receivers for spray-guns. The point was that an ammeter in series would be required in order to give a reading over so many hours, so that there could be a sub-division into power units.

It had been mentioned by the lecturer that if a works was running all night the k.v.a. basis would certainly be cheaper. It would be a generous costing department that would allow the enamelling people such an advantage; they would charge the full rate, saying, "You may go wrong sometimes, and then we will have to face the bill." A night shift would not have reduced overhead charges.

With regard to bonuses and costs he was interested in the case of a shop running on half-production. Whether such a shop should carry its full overheads was a thorny point. It might be subdivided, but, on the other hand, it might be said that the shop was not earning its quota.

The question of the amount of enamel used had been raised. What allowance was to be made for waste, and for washing out the guns?

The Time Factor

MR. WHITTLE, replying, said that a beginning had to be made somewhere, and that was why he dealt with months. Each month was added up, and then the half-year, and then the 12 months. After that, anything that was wanted was divided by 12. It was not possible to get any figure accurately until the stocks at both ends were taken into consideration, which, in the case of a works of any size, only occurred once a year.

Everything that was not debited to a particular job went to overheads. The balance of the expenses of the firm were in the overheads, and a percentage was arrived at which was taken into consideration. The time occupied by the man who stood watching the foreman would be included in overheads. He was actually doing work with a productive article, but a credit should be given on overheads. It was not a matter which occurred very often, but it did happen on special jobs, when someone had to be called in.

In regard to the firm working at half capacity, there should be a development account rather than that they should stand the whole of the cost for a job. Developing a business was creating a goodwill which, in other words, was similar to the incidence of exploiting a patent. Such a development of a business, or the creation of a goodwill, must not be crippled with its percentage of on-cost straightaway. Waste enamel, if it was of any use, was either re-melted or used as first coat.

MR. MURRAY pointed out that the waste which came back into the mill or for re-fritting would be recredited.

MR. WHITTLE said that the total cwts. of enamel used would be divided per output. This brought him to another point which had nothing to do with costing in the first instance. He had seen works where the waste enamel from spray guns had played havoc with the drains, which had become choked, and ultimately the shop floor had to be taken up. He advised the placing of a sump where the vessels were being washed in order that a stoppage of the drains might be obviated.

Total Poundage System

MR. H. BRADLEY said that in regard to the works with which he was associated, the costing system was based upon the total poundage passing through the shop during the week. The direct wages for spraying, fusing, sand-blasting, etc., were ascertained. Then the fuel cost for oil was dealt with, the calculation being based on the amount of oil used in the previous year as contrasted with the number of hours run by the furnaces. The calculation in regard to oil was made per hour and per week, and an average struck according to rise or fall in prices. The next materials dealt with were frit, oxides, clays, etc., which had been used, again in the twelve months. In the first year that this method was adopted, it was necessary to be very cautious in making calculations because it was not always possible to tell whether the results would turn out good or ill. Other considerations were lighting, power, water, and shop purchases, such as gloves, small forks, or any other sundries which had to be bought. Shop supervision was included as an on-cost. All the items were brought together, and taken at so much per lb. Office expenses, and other items which were indeterminable, and could not be really put to enamelling any more than they could to another department, were taken on the direct wages as a percentage.

It was found that this method gave a fairly good average basis on the actual costs per lb. His firm did not deal with sheet iron, which possibly made the problem a little easier to solve. It had been suggested that enamelling with plain colours should be dearer than with mottles and blacks. In his experience, the contrary was the case. He maintained that plain colours could be produced cheaper than mottles as far as labour charges were concerned.

Cost of Plain and Mottled Ware

MR. WHITTLE remarked that Mr. Bradley's firm had adopted a very useful method of costing calculation. It did not matter what a system of costing was if it was founded upon a correct basis, and it was not necessary to have anything very elaborate. A shop dealing solely with enamelling was a very simple one to cost. His experience with regard to the expense of plain colours did not coincide with that of Mr. Bradley. It was said that mottling covered a multitude of sins. With a plain colour there was very little to hide. The rejects, particularly with sheet work, which had to go back for a further coat, were greater in self colours than with mottle or black. It would be cheaper sometimes to put a design on the plate rather than to maintain a self colour. Very slight imperfections might be covered up.

The CHAIRMAN thought it was the general experience that plain colours were the most expensive to produce.

MR. BRADLEY remarked that immediately a plain colour could be produced on a single firing the labour cost must go down in contrast to a mottled effect, because there was only one handling and not two. Mr. MacArthur, in the course of a Paper read earlier in the evening, had given a good explanation how to keep cost down by allowing an operator to do the mottling at the same time, and thus save the expense of double handling.

Incidence of Colour

MR. MACARTHUR said that a great deal depended upon the colour itself. In the case of browns, chocolate brown, or medium brown, he would agree with Mr. Bradley's statement; but if one applied an eggshell blue or an apple green on an average casting, he thought at least two coats would be required.

MR. BRADLEY said he referred to the type of articles dealt with in his own shop, which, in nearly all cases, were of the darker shades.

MR. MACARTHUR suggested that in allocating some particular cost to a colour, it would be difficult to know where to draw the line when one came to the border-line of dark and light shades.

MR. BRADLEY said that pastel shades were worth more from a reject point of view.

MR. WHITTLE remarked that a costs clerk could only cost according to the information he received from the works, and therefore the necessary information should not be withheld from him. Otherwise estimates were liable to be prepared which would result in a loss to the firm. It was to avoid this possibility that costs clerks were given *carte blanche* to ramble about the works seeking what information they desired.

MR. MACARTHUR stressed the importance of keeping milling records in a book, the pages of which had serial numbers. If a man spoiled a mill, and wanted to conceal the fact, he would have to tear out a page. At the weekly checking this would be discovered as the pages would be numbered.

Where Costing Mistakes Occur

MR. MURRAY said a good method also was to have a revolution counter on the mill, so that so many revolutions would represent a milling, and so much milling would represent so many lbs. of enamel. Mr. Whittle had referred to a feeling of mistrust between the accountancy department and the works department. His own experience was that quite a considerable amount of what might be termed fictitious costing went

(*Concluded on page* 374.)

Radiant Tubular-Element System of Heating

DISCUSSION IN LONDON

When Mr. A. A. Straub's Paper* was presented to the Southern Section of The Institute of Vitreous Enamellers, it drew the largest audience so far encountered, whilst only considerations of time prevented still further discussion.

The CHAIRMAN (Mr. V. C. Faulkner), in opening the discussion, said he had been interested in furnaces for a long time, particularly in regard to electric furnaces, and it had occurred to him that the combination of an electric furnace and a tubular furnace might be an advantage, because in an electric furnace the resistors could actually be put in the door of the furnace itself. This would make for efficiency. Since this was a question of a combination of emissivity and radiation, some attention should be paid to the nature of the refractories in the furnace, and he imagined that the smoother the refractory the better would be the radiation. He therefore suggested, if the author had not already tried it, that he should wash the refractories with silicate of soda or some material of that kind. This would give a low melting-point slag of more or less the thickness of the "paint," and this would improve radiation. It would also be interesting to know whether ordinary brickwork or a monolithic lining was used. By such a system as he had just indicated, a very fine surface would be given to monolithic lining, and that would be some help.

Air Movement

Another obvious comment to make was that this furnace appeared to have a volume of imprisoned air. It was almost axiomatic that air was a very bad conductor of heat, and it had been found in connection with low-temperature furnace work that the introduction of a fan or some other means for moving the air about improved the efficiency. A typical case was the heat-treatment of aluminium piston pots for the motor-vehicle industry. The efficiency of the furnace described by the author was of the order of 45 per cent., and in order to visualise what that meant it was interesting to mention that the cupola furnace had an efficiency of 18 to 23 per cent. Therefore, the author's figure of 45 per cent. was a very high one, but unfortunately, in talking of efficiencies, engineers did not always make use of the same methods of calculation. With regard to closing the door, he did not know whether the author was anxious to eliminate the chimney effect, but, in conjunction with the late Mr. Saniter, he was the first to patent a lever-operated eccentric boss mounted on a shaft with the object of tightly closing the door.

Treated Refractory Faces

MR. STRAUB, replying to the question with regard to a combination of an electric and tubular furnace with resistors in the door, said that endeavours were being made to concentrate more heat near the front of the door, and by applying more gas to the front tube, it seemed to him that the same result was accomplished. The use of electricity had never been considered.

As to the refractories inside the furnace he had described, there were 9 in. of the best firebrick which was washed with silicate of soda. A very high-temperature cement was used and the silicate of soda had a very low melting-point, so that there were excellent results from the refractory inside the furnace. With regard to air, less use was made of convection currents than of radiation, and there was no need to get further radiation effects. There was re-radiation from the arch and the walls, and to utilise a fan would be extremely hazardous.

The efficiency of the furnace referred to by the Chairman was the efficiency for the total weight of the ware as charged plus the weight of the bar. In the Lee-Wilson type of furnace, applied to annealing, efficiencies as high as 60 or 65 per cent. were obtained, and that was arrived at by taking the total heat input in B.Th.U's of gas, as burned, against the total heat absorbed by the sheets. In fact, in that furnace they were approaching very nearly the efficiencies obtained in the electric furnace. A refractory insulation for the lining was used which weighed 25 lbs. per cub. ft., and this was the highest refractory that could be obtained. The lining of the furnace was merely insulation. The door wedge used was a very conventional type, consisting of a weight on the door, and they did not depend on chimney effect from loosely fitting doors.

Heating-up Times

MR. J. T. GRAY said he was interested in the point made by the author with regard to the time for heating up the furnace, viz., four hours after a week-end shut-down as compared with 10 to 12 hours, and he presumed this latter figure referred to the refractory box-type muffle. Whilst he agreed that a furnace heated by the metallic tubes would have a much lower thermal capacity than the refractory box-type furnace, he considered that the heating up of the tubes in a short period such as four hours would only represent what might be termed a "flash heat," as the heat input into the brickwork must be taken into consideration, and he could not see how it could reach its working temperature in four hours with anything like a soaking heat which was necessary to get the throughput from the furnace. He could only imagine that the author meant the furnace could be ready for working in four hours, but he felt that the time required for fusing the loads must be longer than normal, and the furnace could not work to its full capacity for the first few hours after starting. A little further information on this point would be useful.

He understood from the author that the temperature of the flue gases leaving the tubes at the point of their egress from the furnace chamber was lower than the temperature in the earlier part of the tubes. If the furnace was working at the uniform temperature which had been emphasised, he would like further information on the matter; he could not see how the flue gases in the tubes could be at a lower temperature than the furnace itself, as while the difference between the temperature inside the tubes and that in the furnace chamber could be very slight, the temperature inside the tubes would be, if anything, slightly the higher.

Another matter on which he would like information was with regard to the flue gases. Was there any possible way of controlling the flue gases? It would appear that they could not be controlled by a damper, as if the end of the tubes was restricted internal pressure might be set up in them which would interfere with combustion.

The speaker also asked for more detailed information on the method of calculating the efficiency of the furnace and whether the total weight of the metal heated was calculated. Did the metal throughput include the perrets and the work, and, if so, what allowance was made, if any, for the heat retained in the perrets? On practically all classes of enamelling perrets represented a large proportion of the load, and could be anything from 25 to 75 per cent. of the total weight of metal heated; these perrets very often returned to the furnace at a fairly high temperature, and if this was not allowed for it could make a serious difference to the final thermal efficiency figure arrived at.

Dampers Eliminated

The AUTHOR, replying to the question with regard to the four hours heating-up time, said that during the first hour there was not the same speed as in the remaining hours, but the ordinary type of furnace would have to be started up on Sunday evening in order to reach the same temperature that the tube furnace did in four hours on Monday morning.

With regard to the temperature control, it was not possible to use a damper on these furnaces owing to the nature of the construction. There was a negative pressure inside the tube, and there was no damper or stack effect in any way. No account was taken of the heat in the metal, because that was virtually impossible. It would mean having thermocouples wired in. In the case he had mentioned, which was hollow-ware, when the sheets were being dealt with at the rate of 12 heats an hour, they were sufficiently hot. He agreed, however, that in the case of hollow-ware, the perret bars could have a serious effect.

Quick Pick-up from Gas Fuel

MR. B. B. KENT asked the author whether natural-draft gas or pressure gas was used. If pressure gas was used he would like to know why natural draft could not be adopted. Continuing, he said he could certainly understand the period of four hours mentioned in comparison with 12 hours for the muffle furnace. He had found that with an ordinary gas-fired furnace the pick-up was about six hours as against 12 hours with oil.

The AUTHOR said that pressure gas was always used because a short flame was necessary, whereas natural draft gave a long flame.

Future for Low-Pressure Gas

MR. W. DIETERICHS (The Gas Light & Coke Company) said he had had an opportunity some time previously of examining a furnace heated in the manner described in the Paper, and had been very much impressed by it. As a result, he had felt that the future of gas furnaces lay in that method of heating, which overcame many difficulties. He believed that in the next few years the gas furnace would be developed on those lines, using low-pressure gas instead of air-blast or high-pressure gas.

A fact which had rather disturbed him was that a furnace such as had been referred to by the author could consume roughly 2,000 cub. ft. of gas per hr., though the consumption would depend, of course, upon the size. If using pressure gas, there was roughly five times that amount of air being entrained at the air chamber, *i.e.*, roughly 10,000 cub. ft. of air per hr. That meant that it was necessary to raise the temperature of 10,000 cub. ft. of air to approximately the temperature of the furnace, and although the furnace was one of the most efficient of its kind, the temperature of the gases leaving the furnace was about the temperature of the interior. No doubt it would be explained that the heat was not wasted, but was taken away and used for drying purposes. That might be a means of getting over the difficulty in an economical way, but he contended the right way in which to do a job was to use the whole of the heat of the fuel in the particular appliance to which it was applied. If the drying ovens had to be used they should be separate units.

He asked whether the author's figures compared a furnace with a high thermal capacity refractory with a furnace having a low thermal

* "Radiant Tubular-Element System of Heating as Applied to the Industry," FOUNDRY TRADE JOURNAL, March 3, 1938, pp. 202-3.

capacity refractory; it was essential, when comparing two furnaces, to ensure that they were really comparative, and that the comparison was not between a furnace with a refractory weighing about 100 lbs. per cub. ft. and another with a refractory weighing 25 lbs. per cub. ft.

At times there was a tendency for a little unconsumed gas to pass out of the top of the Lee-Wilson furnace, and he asked why that should be so if the injectors were properly designed and the consumption correct.

Heat Distribution

The Author said that he must have made a mis-statement or must have been misunderstood with regard to low-pressure gas. As to the use of reclaimed heat for the driers, he said that heat was used in the furnace to start with. Temperatures well above 1,000 deg. C. were being obtained when utilising ordinary blast-furnace gas, which had a very low calorific value, and it was obvious that there must be some means of recuperation, because otherwise such temperatures could never have been attained with a gas of such low calorific value. That was not being done in this country, because there was no real need to do it, but it was being done in Germany.

When he had mentioned 25 lbs. per cub. ft. of brick, he was referring to the Lee-Wilson annealing furnace. In that furnace there was 9 in. of firebrick, weighing 120 lbs. per cub. ft., backed up by an insulating brick weighing 25 lbs. per cub. ft. With regard to governing, he said there was no unconsumed gas coming out of the furnace.

Electric Furnace Control

Mr. E. Chiffey said he had heard it stated that top heat in a furnace was best for vitreous enamel, and he asked whether experimental work had been done in which tubes had been carried round the top of the furnace instead of across the bottom. Discussing the control of electric furnaces, he disagreed with the author's remarks concerning the switching of the load on or off, because in designing an electric furnace to work at a certain temperature one would provide for a load on the furnace which would be equivalent to its minimum working temperature, and that load would always be on. Only about 10 to 20 per cent. of the total load would be controlled automatically by switching on and off from time to time. It should be understood, of course, that a "stand-by" load, which would be quite small, and dependent on the efficiency of the individual furnace, would be available for periods of maintaining temperature when the furnace was not in use.

The Author replied that in his company's first experimental furnace there were tubes through the arch and there was too much top heat. As the result of further experience the maximum heat on that standard type of furnace was applied at a height of 2 ft. 9 in., and it had worked very well. When he had mentioned the load on an electric furnace being switched on and off he had appreciated there was a low setting which would take care of the radiation of the furnace. But with modulated control on the tubular furnace the demand of the furnace could be varied by very small increments between full on and full off. He was by no means deprecating the automatic control of electric furnaces, because he appreciated that good control could be provided; but better control could be obtained with the tubular type of furnace than with an electric furnace.

Corebusters and Efficiency

Mr. Gray, Jun., speaking with regard to the varying locations of the corebusters in the tubes for furnaces operating at different temperatures, asked whether difficulty would be experienced if one were dealing with both cast iron and sheet iron in the one furnace, where the working temperatures would vary from, say, 720 to 900 deg. C. Would the position of the corebusters have to be changed to obtain efficiency? If this was the case, it would appear that changing the corebusters about would be a complicated matter.

The Author replied that corebusters were placed at relevant positions, determined by the maximum quantity of gas to be burned. Where a large volume of gas had to be burned they would be in one position, but for burning a small portion of the gas at the back part of the furnace they would be placed in a different position. It had to be remembered that whilst a great deal of heat was emitted from the tubes at the bottom, there was also at the top accumulated heat due to radiation from the arch and side walls. Thus, whilst there were relatively small areas of the tubes emitting heat directly upwards from the bottom, there were also convection currents through the inside of the furnace which heated the inside of the refractory. No trouble had been experienced in dealing with cast iron.

Mr. Gray, Junr., asked what troubles would arise, if any, if one were trying to deal with both cast iron and sheet iron in one furnace. Would the corebusters have to be changed around?

The Author replied that the corebusters would not have to be changed, because although more heat input would be required for cast iron, one would not burn a greater volume of gas at the high setting. He agreed that bottom heat would be required mostly on sheet iron work.

Corebuster Insertion

The Chairman asked how corebusters were installed. Was it necessary to saw through the tube, insert the corebusters, and weld up again?

The Author replied that it was not necessary to do that. The burner would slide out at the end through a cap, so that the cap could be taken off and the corebuster inserted.

Expansion of Tubes

Mr. A. J. Skinner asked how the horizontal and vertical expansion of the steel tube was taken care of when it was coming up to temperature, because he assumed that there must be a good deal of expansion both horizontally and vertically, and yet the tube was expected to pass through what was practically a solid wall. He also asked what would be the average life of tubes of high nickel content in which town's gas with a relatively high sulphur content was used.

The Author replied that as between the dead cold condition and full heat there was an expansion of approximately 3½ in. laterally in the tube, and the vertical expansion, on 2 ft. 6 in., would be roughly 1¼ in. A definite gap was left in the wall to take care of the expansion. A box was welded to the outside of the furnace; there was a skirt around the opening for the tube, and the inside of the box was filled with sand in order to keep out the air.

He added that there need be no fear as to the life of the tubes in which town's gas was used, because the sulphur content of town's gas, in this country at any rate, was only about 40 to 50 grains per 100 cub. ft. Some of the furnaces were in fact using anthracite producer-gas, coke producer-gas and blast-furnace gas, which contained three or four times as much sulphur as town's gas; indeed, very good results were actually being obtained when burning gas containing 350 grains per 100 cub. ft.

Mr. Dieterichs commented that in some places in this country town's gas containing as little as 20 grains of sulphur per 100 cub. ft. was being supplied.

Convection Heating

Mr. John Fallon said that the use of corebusters was very well known, particularly in superheater practice. He disagreed with the author as to the percentage of heat given off by radiation direct to the work. The tubes were placed in the bottom of the furnace, where they could not radiate heat direct to the work. They were placed there necessarily to heat the air so that it became lighter and tended to rise, whilst the cooler gases tended to fall, so that convection currents were set up. That could not be avoided; indeed, the furnace depended upon it.

With regard to radiant vertical tubes, he could speak with first-hand knowledge, because during the past year he had been connected with the development of furnaces in this country for bright annealing of sheets to the extent of 1,500 tons a week, or more than 50,000 tons a year. The tubes were subjected to very severe tests, and it was found, to his surprise, that a 4½-in. tube could be heated from cold to full emissivity within half an hour; in other words, the full rate of heating was attained within half an hour from a cold start, which was rather remarkable. He was interested also in other types of radiant tubes, including the hairpin type, which came to the front and round to the back again. He asked if the author had achieved the same uniformity of radiation with the horizontal tube as with the vertical tube.

With great wisdom, the author had admitted certain troubles. Had he claimed that no troubles were experienced, one would not have believed him! In his (Mr. Fallon's) experience, it was possible to achieve higher efficiencies with radiant tubes by separating the two functions of the furnace, *i.e.*, the heat generation and heat distribution. It was possible by radiant heat methods to achieve higher efficiencies than by direct flame impingement.

A particularly interesting feature mentioned in regard to the electric furnace was that a fair percentage of the current was left on for low loads or stand-by loads, whereas he had always been under the impression that the standby load on an electric furnace was so small that it could hardly be measured.

Hairpin Tubes

The Author agreed that the use of corebusters was not new; they were used in superheater tubes and in certain types of recuperators. He did not claim that their use was standard practice, but it was fairly well recognised as a good practice.

In the tubular element furnace there were quite a lot of convection currents under the tubes and around the work. Thus, the temperature was transferred from the bottom to the upper part, imparting to the top higher reflection qualities, so that the heat was reflected right on to the work.

The hairpin type of tube had been fitted from the rear in the tubular element furnace. In the case of one of them which had been designed recently it was found that if the furnace were fired from the rear there was not sufficient heat emitted from the front, and if firing were from the front it was difficult or impossible to control the heat from front to back; therefore, a compromise was arrived at, in which the firing was effected from the side and the tubes were spaced irregularly from front to back. Having tried direct-flame burners on heavy charges in annealing furnaces he had found that they gave less efficiency than firing on the radiant tube principle.

Mr. Fallon said he was mystified, because he had understood the author to say that the stack was so arranged that the pull was very small, such pull as there was being made up chiefly by the vertical part of the tube in the furnace. In that case it must be a very small pull, of the order of 1 or 2 hundredths of an inch water gauge. But if high-pressure burners were used, the mixture pressure was bound to be higher than that.

Stack Arrangements

The Author said that there was a stack which would take the products of combustion from the tube. There was a 3-in. tube, and a 6-in. tube surrounding. The 6-in. tube was directly connected by manifolds from the various tubes into a 10-in. tube, which ran along either side of

the furnace and into a stack. There would be a pull of only 2 or 3 hundredths of an inch, because there was a differential, at the point of the flame, of from 1,480 to 1,540 deg. C. to roughly 870 to 925 deg. C.

MR. FALLON said it was not a question of the difference of temperature between the ends of the tube, but the difference between the average temperature of the gas in the tube and the average temperature of the atmosphere outside. He asked if the size of the hole had a great effect.

The AUTHOR replied that one could not use a hole as big as the hand. But there was a strong stack effect, which he was convinced was not an induced effect.

MR. FALLON said that surely at the burner end, as well as at the other end, there was a stack effect.

The AUTHOR agreed.

Vote of Thanks

MR. W. THOMAS (Hon. Secretary, Southern Section) asked whether experiments had been made in regard to the application of oil fuel. He had in mind that in some parts of the world, notably Australia, oil fuel was considerably less expensive than gas. For instance, town's gas was extremely expensive in Sydney. Referring to the shape of the tubes in the tubular element furnace, he asked whether they were circular, or whether they were elliptical in cross-section with a view to securing better radiation.

He proposed a hearty vote of thanks to the author for the Paper.

The vote of thanks was seconded by MR. B. B. KENT, and was carried with acclamation.

The AUTHOR, having responded to the vote of thanks, said he had tried oil fuel on two occasions; it was necessary to gasify the fuel, because otherwise the high velocity of the impingement of the oil on the tubes might open up the tubes. However, further experimental work was being carried out, and he hoped that further information in that connection would be available in the near future.

The tubes used were of circular cross-section. Experiments had been made in which the tubes used were fluted or elliptical, and in some cases fins were welded to the tubes in order to increase the radiation area, but the experiments had failed every time because there was an increase of area and a decrease of the amount of heat which could be emitted from the tubes from underneath.

Some Points Relative to Spraying*

By T. J. MacARTHUR

As it is impossible to cover the entire question of spraying in one Paper, it is proposed to confine the subject to a number of basic factors which have a great bearing on the efficiency of the spray-line in general. Three methods of spraying, *i.e.*, cup feed, gravity feed with the enamel fed to the gun from an overhead container, and pressure feed, are available. The first two methods are particularly useful to the jobbing enameller, or in plants where the operators have to be continually changing their enamels. The less equipment to wash means less time wasted. Another suggestion at this point is that, in a plant of this type, it is advisable to keep one or two spray-booths and a number of spray-guns in reserve, according to the size of the plant, in order that the sprayers may finish one job, and immediately carry on with another, leaving the equipment to be washed by an unskilled operator.

The pressure-feed tank combines the ease of operation of the gravity-feed method with an increase in enamel flow which makes this equipment indispensable in a plant where a large quantity of work is finished in one colour. In the author's plant it has been found that a girl spraying flat sheets in white can spray double the quantity by means of pressure feed as against an ordinary cup-gun, where several seconds are wasted on every piece while filling the gun with enamel.

Air Pressure Control

Control of air pressure is of vital importance whichever method of spraying is used, and the pressure is governed to some extent by the viscosity of the wet enamel. Therefore, if the enamel is kept at a given viscosity, the air pressure must be consistent, otherwise the variation in the atomisation of the enamel will lead to stippling on the surface of the ware.

Oil filters should be incorporated in the air line and regularly cleaned; failure to do this will result in oil passing into the enamel. This also brings up another advantage of the pressure container; enamels are kept much cleaner, as once the container is filled, the enamel remains covered until either the container is emptied or the job is finished, and containers can be obtained to hold from 5 to 200 gallons.

Maintenance

Maintenance of spray-guns is another vital point, and the following methods of ensuring that time wasted on breakdowns is kept to a minimum will no doubt be useful:—(1) All repairs to equipment should be placed in charge of one suitable man, and all equipment be examined weekly; (2) in the plant should be kept a sufficient number of spare guns so that, in the event of a breakdown, the output is not interrupted; and (3) all guns, fluid hose and containers should be thoroughly cleaned at the end of every shift, and be examined by the charge-hand or the shop foreman.

Fluttering

A familiar trouble in spraying is fluttering resulting from an interruption in the flow of enamel. A common cause of this is imperfect fitting of the inner nozzle which allows a small quantity of air to blow back into the flow of enamel. This trouble can also be caused by a poor connection on the fluid hose, which allows air to enter the pipe.

A precaution recommended by most suppliers is to fit a new needle when replacing an old or damaged nozzle, as the old needle, even if only slightly worn, will not make a perfect fit with the new nozzle, and will allow enamel to drip and collect on the outside of the gun.

Handling Problems

The various methods of handling work during spraying do not always receive their full measure of attention. Only too often are sprayers allowed to use their own ideas regarding the correct methods of handling different articles. Although an intelligent sprayer may sometimes hit on the correct method, it should be the duty of the plant foreman to investigate the handling of each different job. For instance, a sprayer accustomed to spraying small castings on a turntable with a round spray will, if transferred to covering flat sheets, use the same methods, whereas the correct method should be to lean the sheet on a fixture and spray with a fan spray, using alternate vertical and horizontal strokes.

A matter which has caused some controversy is whether mottling should be done by the sprayer of the base coat, or by a separate operator in another booth. Personal experience is that by spraying and mottling together a large amount of time is saved, and although difficulties have been encountered they are usually due to one thing—bad matching when several operators are sharing one batch of work. This may be easily overcome by keeping in the plant several samples of each standard mottle effect, and issuing these to the sprayers as required. The samples are then hung on the spray-booth and every casting when mottled is compared with the sample. Apart from the time saved, rejects due to bad marking, and double fixture marking in the case of double-sided work, have been eliminated.

Lay-Out Problems

Correct spacing of spray-booths calls for consideration. When laid out in one straight line a space of 3 ft. should be left between each booth, and the work to be sprayed, or the enamel containers, if too large to be placed under the booth, should be put in this space. This should allow the sprayer a clear working space and path to the dryers. In a number of installations, if sufficient room had been left for quick clear movements, less equipment would have been needed. One has only to imagine a spray-line with no space between the booths. The sprayer finishes a job and awkwardly carries it between enamel containers and skids of work, whereas if this congestion were remedied, the time saved on handling, etc., would increase the quota of sprayed work, and save equipment.

An interesting account was recently given of a certain plant in the U.S.A. where 75 tons of sheet steel are enamelled daily. Three continuous furnaces and a number of box-type furnaces are required to handle this ouput. There are only six spray-booths in the plant, two of which are the automatic type for flat sheets. The balance of firing plant as against spraying plant is indeed remarkable, for although the spray-line probably works 24 hours a day, so must the furnaces.

The spraying operation has a great bearing on the quality of the finished product, and even if the best possible equipment is used, results will be poor unless the operators are of the right type. The necessary degree of skill is only reached by concentration and care, and a good policy to adopt is that of recruiting new sprayers from the filling bench or brushing table, choosing the people who have shown the necessary qualifications in other less important jobs.

DISCUSSION

MR. BRADLEY, referring to the gravity feed, asked if Mr. MacArthur experienced any trouble from settling of the enamel. Did he suggest that there should be some form of agitation in the gravity feed container?

MR. MACARTHUR said he had frequently experienced difficulty with acid-resisting enamels. Probably the only way known at present by which agitation could be effected in a gravity container was in slightly blowing back occasionally on the spray-gun, thus stirring up the enamel with the air as it passed through the enamel. It did not appear to be practical to have mechanical agitation functioning, owing to the added weight. The apparatus had to be used on a pulley, with a rope to haul it up and down in order to refill the container. Any extra weight would add to the danger of either pulling the pulley out or of the rope breaking. It would also be very difficult to pull it up.

Cleaning Methods

MR. BRADLEY further inquired whether there would not be difficulty in cleaning out the tubing carrying the enamel if it was desired to change the colour a day or so afterwards.

MR. MACARTHUR regretted that he could not answer the question definitely, as this depended on the cleaning facilities available. When he had used that type of apparatus, there was usually a high-pressure hose in the mill room, and the person using the apparatus forced a strong jet of water through the hose every night. The same principle could be applied in cleaning

* Paper read before The Institute of Vitreous Enamellers in Manchester, Mr. H. Whitaker presiding.

COLOUR *in the home*

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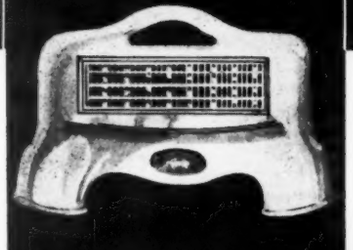

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out spray-booths, namely, to fill the container with water, and actually wash down the booth with the spray-gun. This also partially cleaned the hose. There was a final cleaning off of the hose by running a strong jet of water through it.

Pressure-Feed Tanks

Mr. H. W. Whittle remarked that the pressure-feed tank was indispensable in a plant where large quantities of products were required in one colour. In the case of a plant dealing in lesser quantities of all kinds of colours, would Mr. MacArthur advise the installation of a similar system?

Mr. MacArthur replied in the negative. For instance, the smallest size he had mentioned was one containing five gallons of fluid. It would not be desirable to fill that container and, perhaps after using only two gallons, have to take it back to the mill room and wash out the apparatus. It would have to be washed out most carefully before it was filled with a different colour. If it were possible to use a container full of enamel on one flow of work, there would be a gain in adopting the apparatus owing to extra speed of production. In the case of a sheet-iron shop, with a large volume of white enamel, it worked very well; but in a cast-iron shop, where perhaps only 2 cwts. of black work was done and then there followed the green metal work, and so on, it would be a serious waste of time to use the apparatus, because it was not designed for such a purpose.

Suitable Pressures

Mr. H. Jukes inquired what was the most suitable pressure to use on the pressure containers.

Mr. MacArthur replied that, at present, he was subjecting the container of the enamel to a pressure of from 8 to 10 lbs. A slight variation of pressure was not important. An actual pressure for atomising the enamel at the gun was best between 50 and 55 lbs. It was possible to go up to 60 lbs., but he would not advise lower than 50 lbs.

The Dust Problem

Mr. Bradley said there was always the possibility of trouble through dust blowing in from the foundry on windy days. Had Mr. MacArthur experienced any difficulty with freshly-sprayed enamelware laid on to skids before it was taken into the drying rooms? In his own case the ware was taken into the drying room practically piece by piece; but he had thought many times of taking more pieces together into the drying room.

Mr. MacArthur said the trouble affected everybody, unless a shop was air-conditioned, or so under pressure that no dust could enter from outside sources. It was not advisable to leave cast-iron enamels, sprayed direct, outside the drier, otherwise there would be dust spotting. The practice at his own works was to leave all grey mottled ware until a stack was completed. It was then taken to the drier, but he thought it would be impossible to follow this course with white work, or even with coloured work, on cast iron.

Estimating, Costing and Accounting

(*Concluded from page* 369.)

on. Someone from the accountancy department would ask a man in the workshop how long it would take to do a certain job. Because it is thought that the inquirer is there because he is suspicious, he is told, "About quarter of an hour." A quarter of an hour's time is put down and the same thing occurs in several processes. The costing was made out on that basis, and when the job was actually done it came out much dearer. Sometimes a record was kept of such a cost, and afterwards was brought up again in actual sales analysis. To his mind, this was a very good argument for the adoption of either a bonus or piecework system, in which a man was paid for what he actually did.

Enamelling News

As we briefly mentioned last month, the Scottish Conference of The Institute of Vitreous Enamellers is to be held in Glasgow during the Whitsuntide week-end. On the Saturday, June 4, there is to be a technical session in the small Congress Hall at the Empire Exhibition, when Dr. James White, of the Royal Technical College, Glasgow, is to present a Paper on "Oxidation and Adhesion."

* * *

Sunday is to be a "Joy Day." A motor-coach will leave Glasgow at 9 a.m. to take what the Americans call the "Conventioners" to Pitlochry, passing *en route* the Bridge of Allan and Dunkeld. Here luncheon will be served at the Atholl Palace Hotel. During the afternoon the party will wend its way through Killiecrankie, Loch Tummel, Killin, Lochearnhead, Strathyre and Callander, where the Ancaster Arms Hotel is the *rendezvous*. The return to Glasgow is to be made via Aberfoyle and Strathblane.

* * *

On Whit-Monday morning at 11 a.m. there is to be a second session in the small Congress Hall at the Empire Exhibition. On this occasion an address will be given on "The 1937 Factory Act and other Acts so far as They Affect the Enamelling Industry," by the Chief Inspector, Glasgow District. Then the Chief Medical Inspector of Glasgow is to talk on "The Medical Aspects of the Factory Acts affecting Enamelling Works."

* * *

Whilst foundrymen and enamellers have often sat in joint session to discuss technical matters of common interest, such meetings have invariably been local affairs. This year, at the Annual Conference of the Institute of British Foundrymen, to be held at Bradford in June, Mr. H. Whitaker, a prominent member of the Council of The Institute of Vitreous Enamellers, is to present, on behalf of that body, a Paper on "Sand-Blasting as Applied to the Vitreous Enamelling Process."

* * *

The German enamelling paper, "Emailwaren-Industrie," calls attention to the comparative and correct meanings of the two terms "acid-proof" (säurefest) and "acid resisting" (säurebeständig), which have been more or less universally accepted in Germany, although official distinction between the two terms is still lacking. The German journal points out that strong acids are never used in ordinary utensils, and all enamel can be designated as acid-resisting which is capable of resisting the weak acids encountered in culinary work; these utensils need never be acid-proof. Enamel must be acid-proof where it is used in receptacles exposed to salts, and in other special vessels. Highly acid-proof enamel is required exclusively for chemical plant. This distinction is generally recognised, and suitable test procedure has been evolved by a committee of the Verein deutscher Emailfachleute. It is pointed out that the composition of acid-resisting enamel need not differ much from that of ordinary enamel, but a special composition is required for acid-proof enamel, with a higher silica content and lower boric acid. This modification in composition introduces the first difficulties. About eight years ago Dr. Karmaus divided enamels into acid-resisting, acid-proof and super-acid-proof. Acid-resisting enamel was tested with 10 per cent. acetic acid, and acid-proof with 10 per cent. hydrochloric acid, while super-acid-proof in all cases had to conform with special requirements and specifications. Acid-resisting enamel is comparatively easy to make, but acid-proof enamel requires considerable skill and care. The opinions expressed above in general are in conformity with those held by enamellers in this country.

Spelter Lags Behind

By "Onlooker."

There was a time—and it is beginning to be a long while ago now—when spelter, although it suffered periodically from lapses of price depression, always stood at a higher level than lead. That position is now completely changed, and it is fast becoming the accepted order of things that lead should be priced above spelter, the margin of superiority being some £2, which is just about the advantage spelter enjoyed before the position changed over. Even so, it is not unusual to find the original relative positions of these two metals mentioned as a reason why spelter should prove to be a good lock-up purchase; but it must be admitted that there is little or no indication of any inspired buying on this account. In this connection mention must be made of an anomaly as far as the import duties on the two metals are concerned, for spelter, the cheaper commodity of the two, has to bear a tax of 12s. 6d. per ton while lead gets off relatively lightly at 7s. 6d. Another point worth mentioning is the comparison of units of trading on the Metal Exchange, where lead is dealt in on the basis of 50-ton lots and spelter only 25-ton lots. Obviously some adjustment is necessary here.

It is interesting to consider why these two metals should, as it were, have changed places. An explanation is not easily given, but one or two suggestions may be put forward to account for the altered relationship. In the first place the post-war years have seen very great activity and wide extension in three industries which consume immense quantities of lead, viz., building, cable making and storage batteries. The world fell a long way behind in its building programme, and is still for that matter, so that in the United States there is the prospect of great activity in that direction with a consequent increase in the use of lead. At the same time some of the spelter-using industries have been passing through a difficult time owing to changes in fashion or the substitution of other materials, some of them synthetic in origin. Galvanising, for example, is not so active as it was, and during spells of unduly high copper prices there cannot be any doubt that brass has lost ground to rival materials. Moreover, such lost ground is not too easy to regain. On the other hand, die-casting is progressing to make up some of the leeway, and in certain other directions fresh outlets are being found, so that it would be quite wrong to draw the conclusion that this metal is fighting a losing battle.

Metal Exchange Position

In seeking for an explanation of the fact that lead has achieved and is maintaining a price superiority over spelter, consideration must also be given to the position on the Metal Exchange. When the duties were adjusted from a 10 per cent. *ad valorem* to fixed charges per ton, the possibilities of attracting consumers to put their business through Whittington Avenue were explored, but little or nothing came of it owing largely to the fact that neither high grade nor prime western is in the ordinary way traded there, the basis of transactions being G.O.B. brands. The upshot of this has been that sales of foreign spelter on the market have persisted, and since the metal has been shipped to this country for lodgment in bonded warehouses no subsequent purchases have acted to assist the price level. In addition there is the hedging against their ore holding by the producers, and this is always going on more or less. On the other hand, the position in lead is rather different, for consumers are accustomed to put quite a fair amount of their business through the Exchange since there is not the variety of qualities in lead that exist in spelter.

HOLWELL IRON

in Machine-cast Pigs

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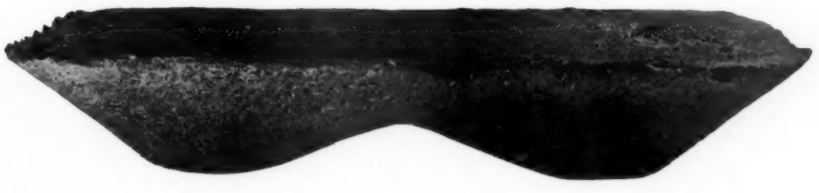
The chemical analysis and well-known physical properties of Holwell Iron remain unaltered.

Holwell Iron is a clean-melting, fluid Pig Iron which produces castings especially suitable for vitreous enamelling.

The Stanton Company have many years' experience of metallurgical problems. This experience is at your disposal on any problem in connection with the Foundry.



The Stanton Ironworks Company Limited, Near Nottingham

The Largest Producers of Foundry Pig Iron (for Sale) in Great Britain

The Week's News in Brief

Trade Talk

THE SOCIETY OF CHEMICAL INDUSTRY is to hold its annual conference in Ottawa from June 20 to 30 next.

THE "PREMIER," one of the oldest passenger-carrying steamers in the world, has been sold to Thos. W. Ward, Limited, of Sheffield, for breaking up.

GLENFIELD & KENNEDY, LIMITED, Kilmarnock, are to supply a steel sluice gate at Staverton factory, near Trowbridge, for the River Avon (Bristol) Catchment Board.

THE STAVELEY COAL & IRON COMPANY, LIMITED, have received a contract from the Derwent Valley Water Board for 48-in. cast-iron pipes and special castings, amounting to 9,000 tons, for the pipe line from Derwent Dam to Bamford Filters.

THE NEW WORKS of A. C. Wickman, Limited, machine-tool specialists, at the Scottish Industrial Estate, Hillington, Glasgow, are now in production. Wimet-brand metal-tipped tools for the Glasgow district are being manufactured at these works.

ADMIRALTY ORDERS to the value of about £2,500,000 were assigned to Clyde shipbuilders during April, while the only merchant order was for a small tanker of about 500 tons. During the month 12 vessels, aggregating 47,213 tons gross, were launched from Scottish yards, the Clyde's quota being nine vessels amounting to 42,953 tons.

A further advance in the wages of Cleveland blast-furnacemen was made operative from May 1. It is announced by the Cleveland Ironmasters' Association that under the new sliding-scale agreement wages are advanced by 2.75 per cent., the district percentages being raised from 46.75 to 49.50. This represents an advance of 36 per cent. since the beginning of last year.

IN ORDER to secure an advertisement for their new "Listard" process, which, they claim, gives the cylinders and liners of their Diesel engines high wear-resistance, R. A. Lister & Company, Limited, of Dursley, are offering their overseas agents and customers all over the world the chance of a free trip to England, the only condition being that the winner spends two days at the company's works. Conditions of a competition which has been arranged in this connection are printed in fifteen languages.

AFTER several weeks' negotiation to secure holidays with pay, an agreement has now been effected between the Welsh Engineers' and Founders' Association and the West Wales Allied Engineering Trades Committee. The agreement, which becomes operative from June 5, will benefit about 1,500 men. Provision is made for placing to the credit of a special fund, to be maintained by each firm for the period covered by the agreement, from June 5, a sum representing one-fiftieth of the appropriate weekly base rate, plus any percentage which may be in force; these credits are to be payable to each employee during a recognised holiday week of six consecutive normal working days. A full week's work is to be 47 hours; statutory bank holidays will count as time worked in computing the holiday pay, and men working on double day shift or three-shift system will be credited with 47 hours for each full shift. Normal holidays are to be from the first Monday in June to the last Saturday in September, and holidays will be taken in relays. Employees asked to work during a stop-week are to be paid ordinary rates and given a holiday on some other date to be mutually agreed; and in the event of an employee leaving before the annual holiday he shall be given a credit note stating the amount of his accrued credits, which note can be presented for payment in the holiday period, and in the case of death accrued credits to be paid into employee's estate. An employees' holiday fund is to be established, into which each employee may contribute weekly, by authorised deductions from his gross weekly earnings, 1s. by those over 21, and 6d. under 21. As the agreement only commences to operate from June 5, the sum to be paid in respect of holidays this year shall be computed on one or either of the following bases: (*a*) the accumulated credits for the period of commencing Sunday, August 1, 1937, to Saturday, June 4, 1938; or (*b*) five-sixths of accumulated credits from Sunday, June 6, 1937, to Saturday, June 4, 1938. The basis decided on shall be that which gives the greater allowance to employee.

Personal

MR. RUDOLPH EULER has been elected a director of the Amalgamated Metal Corporation, Limited.

MR. EDWARD HANLON, chief accountant of the Butterley Company, Limited, has completed 50 years' continuous service with the company.

MAJOR JOHN M. AITON, a director of Aiton & Company, Limited, Derby, was a successful candidate in a by-election for Becket Ward, Derby.

MR. H. H. SHEPHERD, chief metallurgist of Crane, Limited, Ipswich, is sailing on about May 14 for the United States. He will be away about two months.

MR. T. RUSSELL CAIRNS has been elected President of the North-East Coast Institution of Engineers and Shipbuilders in succession to Prof. C. J. Hawkes.

MR. JAMES HENRY SMETHURST, of James Smethurst & Son, iron and brass founders, Old Foundry, Warrington, is to be honoured with the Freedom of Warrington.

SIR FRANCIS JOSEPH was re-elected President of the North Staffordshire Coal and Ironstone Workers' Permanent Relief Society, at the annual meeting at Stoke-on-Trent on Saturday last.

MR. AND MRS. W. H. CHATWIN, of West Tipton, celebrated the fiftieth anniversary of their wedding last week. Mr. Chatwin, who is 79, is chairman of Chatwins, Limited, stove and grate founders, of Albion Street, Tipton.

MR. L. E. MOLD (contracts manager), Mr. H. B. Leeson (technical manager), and Mr. W. A. Harriman (works manager) have been elected to the board of directors of A. Reyrolle & Company, Limited, switchgear manufacturers, of Hebburn-on-Tyne. Mr. Mold, Mr. Leeson and Mr. Harriman have been associated with the company and its developments for many years.

Obituary

MR. SYDNEY J. RICHARDS, a former manager of the Clan Foundry at Belper, has died at the age of 52.

THE DEATH took place last week of Mr. H. P. Lavender, chairman of Voucher, Limited, machine-tool makers, of Upper Bridge Street, Walsall, at the age of 81.

Contracts Open

Rotherham, May 16.—435 yds. of 3 in. dia. cast-iron spigot and socket pipes and special castings, for the Rural District Council. Mr. A. E. Lant, engineer, Grove Road, Moorgate, Rotherham. (Fee £1 1s., returnable.)

Taunton, May 4.—2,700 yds. of 15 in. dia. sand-spun cast-iron pipes, for the Town Council. Mr. E. G. Coles, water engineer, St. Paul's House, Taunton.

Tollesbury, May 16.—One mile 290 yds. of 4 in. dia. spun-iron pipes, for the Maldon Rural District Council. Mr. W. Almond, engineer, 6, Market Hill, Maldon, Essex.

Cheadle, May 14.—Electrically-driven centrifugal pumping plant, for the Rural District Council. Mr. A. P. Hancock, engineer, Council Offices, Cheadle. (Fee £2 2s., returnable.)

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

A. E. Bullen, Limited, 40, Nursery Road, Tunbridge Wells, Kent.—Capital, £500. Iron and brass founders.

R. S. Harrison, Limited.—Capital, £2,000. Soft metal and general founders, etc. Director: R. S. Harrison, Avoncliff, Saltford, Bristol.

Aviation Engineering (Messier) Company, Limited, Westland Works, Yeovil, Somerset.—Capital, £10,000. Two directors to be nominated by Aeronautical & Mechanical Inventions, Limited, and three by Petters, Limited.

Company Reports

Spear & Jackson, Limited.—Dividend of 15 per cent.

Peglers, Limited.—Dividend of 33⅓ per cent. for the year to March 31.

Tube Investments, Limited.—Interim dividend of 10 per cent. on the ordinary stock, and at the same rate relatively on the liaison ordinary shares.

Park Gate Iron & Steel Company, Limited.—Dividend of 5 per cent. for the year to March 31 after writing off £70,000 for depreciation and placing £30,000 to reserve.

Birmingham Small Arms Company, Limited.—Dividend for the six months ended January 31, 1938, on the 5 per cent. "A" cumulative preference stock and on the 6 per cent. "B" cumulative preference stock.

Barrow Hæmatite Steel Company, Limited.—Profit for year ended December 31 last, after payment of interest charges and expenses of re-organisation of loan capital, £100,158; brought in, £4,562; to general reserve, £75,000; dividend on the ordinary shares of 2½ per cent., £17,681; carried forward, £12,039. Meeting, May 20.

Hopkinsons, Limited.—Trading profit to January 31, £171,696; investment income, etc., £5,600; profit on sale of investments, £1,005; depreciation, etc., £20,651; fees and expenses, £2,468; net profit, £155,182; preference dividend, £18,375; tax and N.D.C., £48,000; brought in, £17,511; to reserve, £30,000; to goodwill, patents, etc., £24,399; ordinary dividend of 12½ per cent.; carried forward, £19,106.

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

480,813. HUTCHINSON, E. H., and PEARSON, LIMITED, E. J. & J. Water-cooled furnace walls and furnace arches.

480,855. BRASSERT & COMPANY, LIMITED, H. A., and MILES, J. Manufacture of cast products from blast furnace and like slags.

480,870. NORTON GRINDING WHEEL COMPANY, LIMITED. Case-hardening of iron and steel.

480,893. LIVSEY, D. M. (Brinkman, L. H.). Methods and apparatus for corrugating metal tubes.

480,929. ELECTRO METALLURGICAL COMPANY. Chromium-manganese steel.

480,945. WILLIAMS, W. P. (Rojas Chemical Works, Inc.). Electrolytic deposition of chromium.

480,954. THOMAS & CLEMENT, LIMITED, and BEESTON, W. G. Apparatus for immersion treatment of metal sheets or the like.

481,010. NORSKE AKTIESELSKAB FOR ELEKTROKEMISK INDUSTRI. Self-baking electrodes for electric furnaces.

481,031. RUMBLE, R. W. Composite metal sheets, and structures formed thereof.

481,044. LOEHR, W., and RASSELSTEINER EISENWERKS-GES. AKT.-GES. Reheating furnaces.

481,146. SANCTON, E. H., and STEWART, D. W. Brick units for suspended roofs of furnaces.

Forthcoming Events

MAY 11.

Manchester Association of Engineers:—Visit to works of Linotype & Machinery, Limited, Broadheath, Altrincham, at 2.30 p.m.

Institute of British Foundrymen

MAY 10-12.

London Branch:—West Country visit, to Petters, Limited, Yeovil; Westinghouse Brake & Signal Company, Limited, Chippenham; Newman, Hender & Company, Limited, Woodchester, and Great Western Railway Works, Swindon.

JUNE 14-17.

Thirty-fifth Annual Conference at Bradford.

The Institute of Vitreous Enamellers

JUNE 4-6.

Whitsun Conference at Glasgow (see page 374 for details).

TOR ROCK SAND
for the
FOUNDRY

Higher casting temperatures in iron foundries—particularly in those where special alloys are melted—have resulted in a demand for a moulding sand to withstand severe conditions and produce sound castings of good finish. Tor Rock Sand has proved to be specially suitable for these requirements. It is coarse in grain and highly permeable and being somewhat irregularly graded, tends to give a strong and compact mould surface.

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SWANSEA OFFICE: Metropole Chambers, Wind Street. Telephone: 3680. Telegrams: "Genefax, Swansea." (Mr. D. F. Hood-Williams).

MANCHESTER OFFICE: 9, Albert Square. Telephone: Blackfriars 6130 Telegrams: "Genefax, Manchester." (Mr S. G. Throssell).

MIDDLESBROUGH OFFICE: Halifax Bldgs., Exchange Place. Telephone Middlesbrough 3313. Telegrams: "Genefax, Middlesbrough." (Mr J. A. Williams).

BIRMINGHAM OFFICE: 5, Lower Temple Street. Telephone: Midland 6376 Telegrams: "Genefax, Birmingham." (Mr. G. Griffiths)

Raw Material Markets

Although most producers have now brought their deliveries up to schedule, few consumers are placing orders of any size. No doubt business will continue to be small until the prices for the second half of the year have been announced. Pig-iron consumers believe that reductions on present quotations may be made.

Pig-Iron

MIDDLESBROUGH.—The output of Cleveland foundry iron is still limited, and makers are relying on their stocks to meet the current demand. Some producers have substantial deliveries still to be made under existing contracts, while others have cleared their commitments. Consumers will not enter into business involving deliveries after the end of June, but some orders have been placed for May/June. For delivery in Middlesbrough and Falkirk up to the end of June, No. 3 Cleveland G.M.B. foundry iron is quoted at 109s., No. 4 foundry and No. 4 forge at 108s., and No. 1 foundry at 111s. 6d., all less 5s. per ton rebate.

Consumers experience no difficulty in obtaining their full requirements of hematite, and there is a good surplus after deliveries have been made. The output in March was higher than in each of the two preceding months. It is anticipated that there will be an expansion of demand when the plans to accelerate the rearmament programme get under way, while it is also hoped that there will be an improvement in the overseas demand, though there are no indications of this at present. For delivery on the North-East Coast up to the end of the year, East Coast mixed numbers are quoted at 132s. 6d. per ton, 138s. in Sheffield, and 143s. 6d. in the Midlands.

LANCASHIRE.—There is little in the way of new business in this area, and consumers are likely to continue to pursue a reserved policy until the prices for deliveries during the second half of the year are made known. There have been instances of consumers booking tonnages up to September, but long-term buying is not generally favoured. The light-castings foundries still do not seem to be receiving orders satisfactorily, but it is expected that this section will shortly be better employed. Textile engineers, also, are working below their normal capacity, but most other consumers of foundry iron are taking up good tonnages. A moderate demand is being received for hematite, but there is only a small amount of new business being transacted at the present time. Supplies are well in excess of demand.

MIDLANDS.—Little interest is being shown in high-phosphoric iron and consumers are taking only small tonnages as required. It is likely that there will be a further reduction in the output in the near future. No improvement is reported among the light-castings makers and the dullness in this section largely accounts for the weak demand for foundry iron. For delivery to Birmingham and Black Country stations, Northants No. 3 is quoted at 108s. 6d., with Derbyshire No. 3 at 111s. The demand for forge iron is still unsatisfactory, but there has been further expansion in the call for supplies of low-phosphoric iron. Quotations for this type of iron range from £5 15s. up to £7 per ton. Refined iron is also moving away in larger tonnages; the Association price of £8 5s. is being ignored by many producers outside the Association and much lower quotations are being offered in order to induce business. Prices of hematite have been fixed up to the end of the year, but even this security is insufficient to produce much new business. East Coast hematite is quoted at £7 3s. 6d. and West Coast £7 4s. 6d.

SCOTLAND.—There are fairly substantial stocks of iron on hand at many of the consuming plants, and buyers have little need to place further orders at the present time. In any case, they are expecting a reduction in prices at the end of the first half of the year and will leave as much of their buying as possible until then. No. 1 foundry iron is currently quoted at 120s. 6d., with No. 3 at 118s., f.o.t. furnaces. Short time is still being worked at several of the light-castings foundries, but there should be material improvement in this section before long. Supplies of Cleveland iron are available, but no business appears to be going through; the price of this iron is 109s. f.o.t. Falkirk and 112s. f.o.t. Glasgow. Local steelworks continue to work to capacity. Hematite mixed numbers are quoted at 133s., Scottish basic at 107s. 6d., and English and Indian basic 100s., all less 5s. per ton rebate, delivered to steelworks here.

Coke

No reductions in prices can be obtained on the foundry-coke market. Producers state that current quotations will remain in force at least up to the end of the year. For delivery to Birmingham and district, best Durham foundry coke is quoted at 55s. 9d., with Welsh coke at 55s. to 62s. 6d.

Steel

Although the steel market continues quiet, production remains at a high rate, particularly on the heavy side of the industry. Several steel-making firms are still in arrears with deliveries, but for some time past the volume of new orders has been much less than the tonnage of completed work, and it is now possible to obtain near delivery of most descriptions of steel. The industrial requirements of semi-finished steel are at a low ebb, owing to the heavy accumulations held by consumers. It will be some months probably before the position is readjusted, but, in the meantime, important tonnages are passing regularly into consumption. In the lighter branches of the steel trade, conditions are quiet and production has slowed down somewhat. Export business has been irregular, but the inquiry from some of the overseas markets has expanded, and there appears to be a tendency on the part of buyers to make larger purchases.

Scrap

Conditions in the iron and steel scrap market remain rather quiet and consumers have heavy stocks on hand. Merchants generally have substantial quantities for disposal, but little business can be transacted until stocks have been appreciably lowered. In many districts, consumers recently suspended deliveries, but small tonnages are now being taken up.

Metals

The turnover in all metals during the past week has been small and there are no signs of returning confidence on the part of consumers. The price of tin on Monday fell to the lowest level for more than five years.

Copper.—There has been a slight expansion in the demand for copper recently, although the position remains unsatisfactory as far as business is concerned. The undertone of the market is fairly sound. It is understood that representatives of leading international copper companies will meet in London within the next day or so to discuss the copper restriction agreement. The present output quota is 105 per cent. of agreed tonnages and it is not expected that this figure will be altered as a result of the meetings. Speaking at the recent meeting of the Rio Tinto Company, Limited, Sir Auckland Geddes, chairman, said that the long-term prospects for copper were, in his view, good, but obviously, with conditions in the United States as they were, supplies could only be closely related to demand by agreement between a sufficient number of producers of an adequate proportion of the world supply. The associated copper producers were engaged at present in one of their periodical reviews of the position.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £39 15s. to £39 17s. 6d.; Friday, £39 3s. 9d. to £39 6s. 3d.; Monday, £38 11s. 3d. to £38 12s. 6d.; Tuesday, £38 3s. 9d. to £38 5s.; Wednesday, £38 12s. 6d. to £38 13s. 9d.

Three Months.—Thursday, £40 1s. 3d. to £40 2s. 6d.; Friday, £39 10s. to £39 11s. 3d.; Monday, £38 16s. 3d. to £38 17s. 6d.; Tuesday, £38 8s. 9d. to £38 10s.; Wednesday, £38 18s. 9d. to £39.

Tin.—The April issue of the Statistical Bulletin of the International Tin Research and Development Council states that world tin production in the first two months of 1938 amounted to 26,800 tons, as compared with 28,300 tons in the corresponding period of 1937. World apparent tin consumption in the first two months amounted to 26,400 tons, as compared with 31,500 tons in the same period of 1937. The total consumption of tin in manufacture is estimated to have amounted to 23,500 tons and 28,700 tons respectively; the tinplate industry accounted for 7,000 and 10,700 tons respectively. The apparent consumption of tin in the United Kingdom in the first quarter of this year was 4,378 tons, against 6,354 tons in the first quarter of 1937. World tinplate production in the first quarter of 1938 amounted to 672,000 tons, against 1,022,000 tons in the corresponding period of 1937. During March, 1938, visible stocks increased by 3,815 tons to 27,123 tons, representing 14.5 per cent. of the current annual rate of consumption.

According to the monthly statistics compiled by Mr. W. H. Gartsen (Henry Rogers, Sons & Company), the total visible supply of tin on April 30 amounted to 19,041 tons, as compared with 18,037 tons on March 31. The tin carried over at the Straits Settlements was 6,279 and 6,469 tons respectively, and at the Arnhem (Holland) smelter 3,582 and 2,617 tons respectively.

The tin market has displayed renewed weakness this week, the price falling to £155 per ton on Monday, which is the lowest level since April, 1933. Uncertainty with regard to the buffer pool still persists. According to a London report, a referendum will be held among Malayan tin producers within the next few days. The Malayan chief inspector of mines, Mr. H. G. Harris, has recently said that the life of the industry was continually being extended by prospecting, and that it might go on for many years yet. He based this opinion on the fact that the reserves of tin ore could not be known until there had been borings all over the peninsula, and, also, on the probability of rich reserves yet undiscovered in the hills. Moreover, dredges working the alluvial deposits on the flats were not recovering all the tin where the limestone bottom was uneven, and it was likely that these areas would be worked over again with gravel pumps.

Official quotations were as follow :—

Cash.—Thursday, £164 10s. to £164 15s.; Friday, £161 10s. to £161 15s.; Monday, £155 to £155 10s.; Tuesday, £153 5s. to £153 7s. 6d.; Wednesday, £160 to £160 5s.

Three Months.—Thursday, £165 to £165 2s. 6d.; Friday, £162 5s. to £162 7s. 6d.; Monday, £156 to £156 5s.; Tuesday, £153 17s. 6d. to £154; Wednesday, £160 15s. to £161.

Spelter.—The current output of spelter in Europe is in excess of the demand, and steps are likely to be taken in the near future to come to some agreement for the restriction of production. Business is unsatisfactory at present, and there does not seem to be any likelihood of any early expansion. Some slight improvement has taken place in the United States, and the position is now viewed more favourably.

Daily market prices :—

Ordinary.—Thursday, £13 12s. 6d.; Friday, £13 8s. 9d.; Monday, £12 7s. 6d.; Tuesday, £12 12s. 6d.; Wednesday, £12 17s. 6d.

Lead.—A very dull tone has prevailed in this market, and business has involved small tonnages only. The "Metallgesellschaft" reports that the world's smelter output of lead in February amounted to 126,698 metric tons, against 136,347 tons in the previous month.

Day-to-day quotations :—

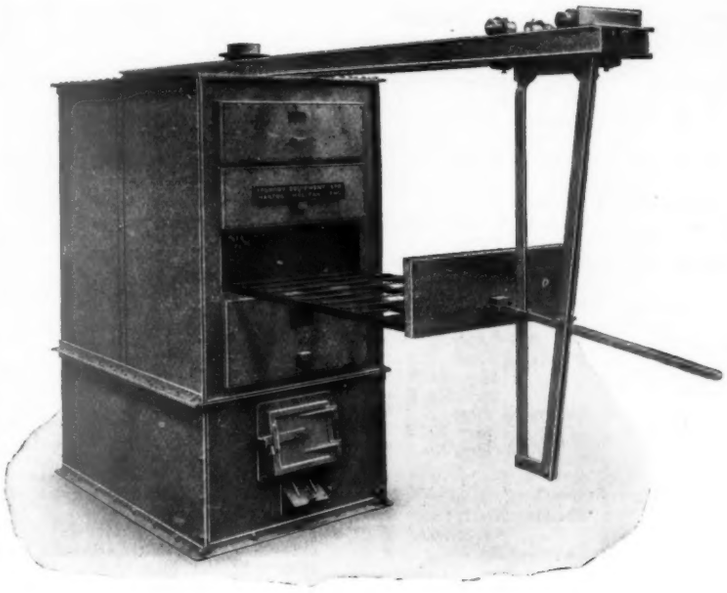
Soft Foreign (Prompt).—Thursday, £15 3s. 9d.; Friday, £14 18s. 9d.; Monday, £14 13s. 9d.; Tuesday, £14 8s. 9d.; Wednesday, £14 17s. 6d.

Scrap.—Home and export business continues to be on a small scale, and inquiries appear to be difficult to convert into actual orders. Many of the consuming plants have only just restarted following the Easter holidays, and some expansion may result when the works are again operating normally.

Approximate selling prices for old metal:—New aluminium cuttings, £77; rolled, £64; cast, £34; foil, £88. Copper, £36 to £39; braziery, £34. Brass (clean), £22 to £25. Zinc, £7 10s. Lead, £12. Gunmetal, £38 to £39.

British Timken, Limited

Presiding at the annual meeting of British Timken, Limited, MR. M. B. U. DEWAR, chairman, said that the works had been kept very fully employed, and the output was the highest in the company's history. Not only had there been a very considerably increased demand for the usual applications of the company's products, but also for new applications which necessarily involved considerable capital expenditure on new plant and equipment. Their turnover in the railway machine tool and rolling-mill fields had steadily increased. In particular, the demand for Timken bearings for railway axleboxes showed during the year under review a very considerable increase over any previous year.



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Write for "Sirocco Products" summarising pictorially our manufacturing activities.

Davidson & Co. Ltd., *Sirocco Engineering Works*, Belfast

LONDON - MANCHESTER - GLASGOW - BIRMINGHAM - NEWCASTLE - CARDIFF - DUBLIN

RAW MATERIALS—PRICE LIST

(Wednesday, May 4, 1938)

COPPER

	£	s.	d.
Standard cash	38	12	6
Three months	38	18	9
Electrolytic	43	0	0
Tough	41	10	0
Best selected	42	0	0
Sheets	73	0	0
India	54	12	6
Wire bars	43	5	0
Ingot bars	43	5	0
H.C. Wire rods	46	15	0
Off. av. cash, Apr.	39	7	0 9/19
Do., 3 mths., Apr.	39	12	2 16/19
Do., Sttlmnt., Apr.	39	7	2 16/19
Do., Electro, Apr.	43	17	2 16/19
Do., B.S., Apr.	43	12	6
Do., Wire bars, Apr.	44	6	3 15/19
Solid drawn tubes			12½d.
Brazed tubes			12½d.
Wire			8d.

BRASS

Solid drawn tubes	11d.
Brazed tubes	13d.
Rods, drawn	9d.
Rods, extd. or rlld.	6½d.
Sheets to 10 w.g.	8½d.
Wire	8½d.
Rolled metal	7½d.
Yellow metal rods	6½d.

TIN

	£	s.	d.
Standard cash	160	0	0
Three months	160	15	0
English	160	0	0
Bars	162	0	0
Straits	162	0	0
Eastern	162	10	0
Banca (nom.)			—
Off. av. cash, Apr.	168	15	5 10/19
Do., 3 mths., Apr.	169	7	7 1/19
Do., Sttlmt., Apr.	168	15	0

SPELTER

	£	s.	d.
Ordinary	12	17	6
Remelted	10	5	0
Hard	10	5	0
Electro, 99.9	16	16	3
English	13	17	6
India	12	10	0
Zinc dust	17	15	0
Zinc ashes	5	0	0
Off. aver., Apr.	13	16	5 29/38
Aver., spot, Apr.	13	14	6 13/38

LEAD

	£	s.	d.
Soft foreign, ppt.	14	17	6
Empire (nom.)	15	5	0
English	16	15	0
Sheets, home	23	5	0
Do. export	19	0	0
Pipes, home	22	15	0
Do. export	19	12	6
Tea lead	30	15	0
Off. aver., Apr.	15	12	0 3/10
Aver., spot, Apr.	15	11	6 15/19

ALUMINIUM

Ingots	£100 to £105
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 to 1/4 lb.

ZINC SHEETS, &c.

	£	s.	d.	£	s.	d.
Zinc sheets, English	27	5	0 to	27	15	0
Do., V.M. ex-whse.	27	5	0 to	27	15	0
Rods			19	0	0	

ANTIMONY

	£	s.	d.	£	s.	d.
English	75	0	0 to	78	0	0
Chinese, ex-whse.			61	0	0	
Crude, c.i.f.			37	0	0	

QUICKSILVER

Quicksilver	12	5	0

FERRO-ALLOYS AND STEEL-MAKING METALS

	£	s.	d.	£	s.	d.
Ferro-silicon—						
25%	12	10	0			
45/50%	12	0	0			
75%	17	0	0			
Ferro-vanadium—						
35/50%	14/- lb. Va.					
Ferro-molybdenum—						
70/75% carbon-free	4/9 lb. Mo.					
Ferro-titanium—						
20/25% carbon-free	9d. lb.					
Ferro-phosphorus, 20/25%	£21 to £22					
Ferro-tungsten—						
80/85%	4/8 lb.					
Tungsten metal powder—						
98/99%	4/9½ lb.					
Ferro-chrome—						
2/4% car.	34	15	0			
4/6% car.	24	5	0			
6/8% car.	24	0	0			
8/10% car.	24	0	0			
Ferro-chrome—						
Max. 2% car.	36	0	0			
Max. 1% car.	38	5	0			
Max. 0.5% car.	41	0	0			
70% carbon-free	10d. lb.					
Nickel—99.5/100%	£180 to £185					
"F" nickel shot	£165	0	0			
Ferro-cobalt, 98/99%	8/6 to 8/9 lb.					
Metallic chromium—						
96/98%	2/5 lb.					
Ferro-manganese—						
76/80% loose	£18	15	0 to 19	5	0	
76/80% packed	£19	15	0 to 20	5	0	
76/80% export	£22	0	0			
Metallic manganese—						
94/96% carbon-free	1/3 lb.					

Per ton unless otherwise stated, basis 2-ton lots.

SCRAP

	£	s.	d.	£	s.	d.
South Wales (West)—						
Heavy steel, best	3	8	9 to	3	11	3
Mixed iron and steel	3	6	9 to	3	9	3
Heavy cast iron	3	8	9 to	3	11	3
Good machinery	3	12	6 to	3	15	0
Cleveland—						
Heavy steel, best	3	7	0 to	3	9	6
Steel turnings	2	13	0 to	2	15	6
Heavy cast iron				3	12	6
Heavy machinery				4	0	0
Midlands—						
Short heavy steel				3	12	6
Light cast-iron scrap				3	2	6
Heavy wrought iron	4	0	0 to	4	5	0
Steel turnings	2	6	3 to	2	8	9
Scotland—						
Heavy steel, best	3	5	0 to	3	7	6
Ordinary cast iron	3	15	0 to	3	17	6
Cast-iron borings	2	0	6 to	2	3	0
Wrot-iron piling	4	5	0 to	4	7	6
Heavy machinery	4	1	6 to	4	2	6

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	31	0	0
Brass	20	0	0
Lead (less usual draft)	11	10	0
Tea lead	8	0	0
Zinc	6	0	0
New aluminium cuttings	67	0	0
Brazier copper	28	0	0
Gunmetal	30	0	0
Hollow pewter	110	0	0
Shaped black pewter	75	0	0

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	3s. 0d.
Finished bars, 18% tungsten	3s. 10d.

Per lb. d/d buyers' works.

PIG-IRON*

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	111/6
" No. 3	109/-
" No. 4	108/-
Forge No. 4	108/-
Hematite No. 1	133/-
Hematite M/Nos.	132/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	133/-
" d/d Birm.	144/6
Malleable iron d/d Birm.	160/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	110/-
" No. 3 fdry.	111/-
Northants forge	107/6
" fdry. No. 3	108/6
" fdry. No. 1	111/6
Derbyshire forge	110/-
" fdry. No. 3	111/-
" fdry. No. 1	114/-
Scotland—	
Foundry, No. 1, f.o.t.	120/6
" No. 3, f.o.t.	118/-
Cleveland No. 3, Glasgow	112/-
" " Falkirk	109/-
Scottish hem. M/Nos. d/d	133/-
Sheffield (d/d district)—	
Derby forge	107/6
" fdry. No. 3	108/6
Lincs forge	107/6
" fdry. No. 3	108/6
W.C. hematite	138/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	114/-
Staffs fdry. No. 3	114/-
Northants fdry. No. 3	112/6
Cleveland fdry. No. 3	114/-
Glengarnock, No. 3	140/-
Clyde, No. 3	140/-
Monkland, No. 3	140/-
Eglinton, No. 3	140/-
Gartsherrie, No. 3	140/-
Shotts, No. 3	140/-

(* Prices of hematite and basic pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton under certain conditions.)

FINISHED IRON AND STEEL

Usual district deliveries.

[A rebate of 15/- per ton for steel sections, plates and joists is obtainable in the home trade under certain conditions.]

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	13	5	0 to	13	15	0
Nut and bolt iron	11	12	6 to	12	2	6
Hoops				14	2	6
Marked bars (Staffs) f.o.t.				15	15	0
Gas strip				14	2	6
Bolts and nuts, ¾ in. × 4 in.				17	10	0 and up
Steel—						
Plates, ship, etc.	11	8	0 to	11	10	6
Boiler plts.	11	18	0 to	12	0	6
Chequer plts.				13	0	6
Angles				11	0	6
Tees				12	0	6
Joists				11	0	6
Rounds and squares, 3 in. to 5½ in.				12	0	6
Rounds under 3 in. to ¾ in. (untested)				12	4	0
Flats—8 in. wide and over				11	5	6
" under 8 in. and over 5 in.				11	10	6
Rails, heavy				10	2	6
Fishplates				14	2	6
Hoops (Staffs)				12	19	0
Black sheets, 24g. (4-t. lots)				15	15	0
Galv. cor. shts. (")				18	10	0
Galv. flat shts. (")				19	0	0
Galv. fencing wire, 8g. plain				20	5	0
Billets, soft, 100-ton lots				7	17	6
Sheet bars				7	15	0
Tin bars				7	15	0

PHOSPHOR BRONZE

	Per lb. basis
Strip	10½d.
Sheet to 10 w.g.	11½d.
Wire	12½d.
Rods	13d.
Tubes	18½d.
Castings	15d.

Delivery 3 cwt. free.
10% phos. cop. £33 above B.S.
15% phos. cop. £38 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	8d. to 1/2
Rolled—	
To 9 in. wide	1/2 to 1/8
To 12 in. wide	1/2½ to 1/8½
To 15 in. wide	1/2½ to 1/8½
To 18 in. wide	1/3 to 1/9
To 21 in. wide	1/3½ to 1/9½
To 25 in. wide	1/4 to 1/10
Ingots for spoons and forks	8d. to 1/4½
Ingots rolled to spoon size	11d. to 1/7½
Wire round—	
to 10g.	1/5½ to 2/0½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/4½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	25.84
No. 2 foundry, Valley	24.00
No. 2 foundry, Birm.	20.38
Basic, Valley	23.50
Malleable, Valley	24.00
Grey forge, Valley	23.50
Ferro-mang. 80%, seaboard	102.50
O.-h. rails, h'y, at mill	42.50
Billets	37.00
Sheet bars	37.00
Wire rods	47.00
	Cents.
Iron bars, Chicago	2.40
Steel bars	2.45
Tank plates	2.25
Beams, etc.	2.25
Skelp, grooved steel	2.10
Steel hoops	2.40
Sheets, black, No. 24	3.15
Sheets, galv., No. 24	3.80
Wire nails	2.75
Plain wire	2.90
Barbed wire, galv.	3.40
Tinplates, 100-lb. box	$5.35

COKE (at ovens)

Welsh foundry	42/6
" furnace	34/6
Durham foundry	39/6
" furnace	32/6
Scottish foundry	42/-
" furnace	35/6 to 37/6

TINPLATES

f.o.b. British Channel ports.

I.C. cokes	20×14 per box		20/3
"	28×20 "		40/6
"	20×10 "		29/-
"	18¾×14 "		21/-
C.W.	20×14 "		19/-
"	28×20 "		38/-
"	20×10 "		28/8
"	18¾×14 "		20/3

SWEDISH CHARCOAL IRON & STEEL

	£	s.	d.	£	s.	d.
Pig-iron	£11	0	0 to	£12	0	0
Bars-hammered, basis	£20	0	0 to	£22	0	0
Bars and nail-rods, rolled, basis	£19	0	0 to	£20	0	0
Blooms	£18	0	0 to	£19	0	0
Keg steel	£30	0	0 to	£35	0	0
Faggot steel	£19	0	0 to	£24	0	0
Bars and rods dead soft st'l	£14	0	0 to	£16	0	0

All per English ton, f.o.b. Gothenburg
[Subject to an exchange basis of Kr. 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

			£	s.	d.		
Apr.	28	..	39	15	0	inc.	1/3
,,	29	..	39	3	9	dec.	11/3
May	2	..	38	11	3	,,	12/6
,,	3	..	38	3	9	,,	7/6
,,	4	..	38	12	6	inc.	8/9

Electrolytic Copper

			£	s.	d.		
Apr.	28	..	44	0	0	inc.	10/-
,,	29	..	43	5	0	dec.	15/-
May	2	..	42	10	0	,,	15/-
,,	3	..	42	5	0	,,	5/-
,,	4	..	43	0	0	inc.	15/-

Standard Tin (cash)

			£	s.	d.			
Apr.	28	..	164	10	0	No	change	
,,	29	..	161	10	0	dec.	60/-	
May	2	..	155	0	0	,,	130/-	
,,	3	..	153	5	0	,,	35/-	
,,	4	..	160	0	0	inc.	135/-	

Tin (English ingots)

			£	s.	d.			
Apr.	28	..	164	10	0	No	change	
,,	29	..	161	10	0	dec.	60/-	
May	2	..	153	5	0	,,	35/-	
,,	3	..	153	5	0	,,	35/-	
,,	4	..	160	0	0	inc.	135/-	

Spelter (ordinary)

			£	s.	d.		
Apr.	28	..	13	12	6	inc.	1/3
,,	29	..	13	8	9	dec.	3/9
May	2	..	12	7	6	,,	21/3
,,	3	..	12	12	6	inc.	5/-
,,	4	..	12	17	6	,,	5/-

Spelter (Electro, 99.9 per cent.)

			£	s.	d.			
Apr.	28	..	17	8	9	No	change	
,,	29	..	17	5	0	dec.	3/9	
May	2	..	16	5	0	,,	20/-	
,,	3	..	16	11	3	inc.	6/3	
,,	4	..	16	16	3	,,	5/-	

Lead (soft foreign, prompt)

			£	s.	d.		
Apr.	28	..	15	3	9	inc.	3/9
,,	29	..	14	18	9	dec.	5/-
May	2	..	14	13	9	,,	5/-
,,	3	..	14	8	9	,,	5/-
,,	4	..	14	17	6	inc.	8/9

Lead (English)

			£	s.	d.		
Apr.	28	..	17	5	0	No	change
,,	29	..	17	0	0	dec.	5/-
May	2	..	16	15	0	,,	5/-
,,	3	..	16	10	0	,,	5/-
,,	4	..	16	15	0	inc.	5/-

AVERAGE MONTHLY PRICES OF IRON HOOPS.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1902	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6
1903	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 0
1904	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6
1905	6 17 6	7 0 0	7 0 0	7 0 6	7 0 0	7 0 0	7 2 6	7 2 6	7 2 6	7 7 6	7 0 0	7 7 6	7 2 0½
1906	7 10 0	7 17 6	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	8 7 6	7 15 1½
1907	8 7 6	8 7 6	8 7 6	8 7 0	8 7 6	8 7 6	8 10 0	8 10 0	8 10 0	8 5 0	8 5 0	8 0 0	8 7 1
1908	8 0 0	7 10 0	7 10 0	7 10 6	7 10 0	7 10 0	7 10 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 6 8
1909	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0
1910	7 1 10½	7 6 3	7 7 6	7 7 0	7 7 6	7 7 6	7 7 6	7 7 6	7 7 6	7 6 3	7 5 0	7 5 0	7 6 5
1911	7 5 0	7 5 0	7 5 0	7 5 6	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 8 9	7 10 0	7 10 0	7 6 2½
1912	7 12 6	7 12 6	7 12 6	7 15 0	8 2 6	8 2 6	8 2 6	8 2 6	8 12 6	8 12 6	8 12 6	8 15 0	8 2 3½
1913	8 17 6	8 17 6	8 17 6	8 17 0	8 17 6	8 17 6	8 17 6	8 7 6	8 7 6	8 7 6	8 7 6	7 17 6	8 12 6
1914	7 17 6	7 17 6	7 17 6	7 13 9	7 12 6	7 12 6	7 12 6	9 2 6	9 2 6	9 2 6	9 2 6	9 2 6	8 6 4½
1915	9 3 6	9 18 1	10 7 6	10 16 6	10 17 6	13 2 6	13 2 6	13 2 6	13 7 6	14 2 6	15 2 6	15 18 6	12 10 1
1916	16 5 0	15 13 9	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	13 4 0½
1917	17 2 6	17 2 6	17 2 6	17 2 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 6 1
1918	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6
1919	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6
1920	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6
1921	17 2 6	17 2 6	17 2 6	17 2 6	24 6 3	24 6 3	24 6 3	25 9 0	26 7 6	26 7 6	26 7 6	26 17 4	22 14 9
1922	28 0 0	28 12 6	33 15 0	35 5 0	35 15 10	38 17 6	38 17 6	38 17 6	38 17 6	38 17 6	36 17 6	36 17 6	35 14 9
1923	29 1 3	23 5 0	21 12 6	20 0 0	20 0 0	20 0 0	17 5 0	15 0 0	14 4 0	13 15 0	13 10 0	12 18 0	17 5 10
1924	14 15 0	14 15 0	14 15 0	14 15 0	14 15 0	14 13 9	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 12 4½	
1925	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	
1926	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	
1927	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	12 10 0	12 10 0	14 3 4
1928	12 10 0	12 7 6	12 0 0	11 13 6	11 15 0	11 12 6	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 14 10½
1929	11 10 0	11 10 0	11 10 0	11 10 0	11 9 0	11 5 0	11 5 0	11 5 0	11 2 0	11 0 0	11 0 0	11 0 0	11 5 11
1930	11 0 0	11 0 0	11 0 0	10 16 3	10 15 0	10 15 0	10 15 0	10 15 0	10 15 0	10 15 0	10 15 0	10 15 0	10 16 4½
1931	10 15 0	10 15 0	10 15 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 11 3
1932	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0
1933	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0
1934	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0
1935	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0
1936	10 10 0	10 12 6	11 0 0	11 0 0	11 0 0	11 0 0	11 0 0	11 3 9	11 7 6	11 7 6	11 7 6	11 7 6	11 1 4½
1937	11 7 6	11 7 6	12 15 0	12 15 0	12 15 0	12 15 0	13 6 0	14 2 6	14 2 6	14 2 6	14 2 6	14 2 6	13 2 9½
1938	14 2 6	14 2 6	14 2 6	14 2 6	—	—	—	—	—	—	—	—	—

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

FITTER requires position in Lancashire area or South England, either as Fitter or Foreman. First-class range and stove experience; knowledge foundry practice. Technical training.—Box 910, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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SAND MIXERS AND AERATORS.—The "Breakir" Centrifugal Machine is *THE* machine. Outputs 10 cwts. to 8 tons per hr.—W. BREALEY & Co., LTD., Station Works, Ecclesfield, Sheffield.

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INGERSOLL RAND Steam-driven Compressor, 355 c.f.p.m., 100 lbs. w.p.
2½-ton Morris Overhead Hand Crane, 19 ft. 6 in. span.
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TABOR Portable Shockless Moulding Machine for 24″ × 48″ boxes Price £90
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Tilting furnaces for brass, 16 in stock
Air Compressors, all types in stock
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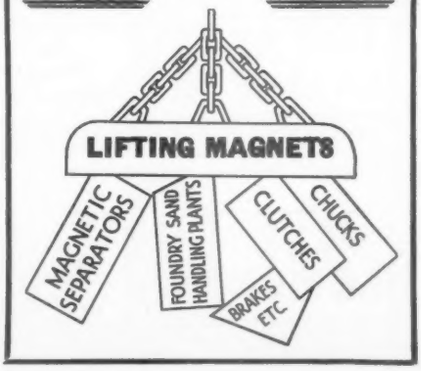
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